SITE QUALITY ASSURANCE PROJECT PLAN

Jewett White Lead Company Site
Staten Island, New York

Prepared by

Removal Support Team 2
Weston Solutions, Inc.
Northeast Division
Edison, New Jersey 08837

Prepared for

U.S. Environmental Protection Agency
Region II - Removal Action Branch
Edison, New Jersey 08837

DCN: RST 2-02-F-0755
TDD #: TO-0009-0126
EPA Contract No.: EP-W-06-072

Approved by:

RST 2

Gary Boyer
Site Project Manager

Date: 12/10/08

RST 2

Smita Sumbaly
Chemist/QA/QC Specialist

Date: 12/10/08

EPA

Nick Magriples
On-Scene Coordinator

Date: 12/11/08

TABLE OF CONTENTS

TABLE OF CONTENTS
(Continued)

The following elements are provided in the RST 2 Generic Quality Assurance Project Plan (QAPP) and are included by reference:

LIST OF ATTACHMENTS

1. INTRODUCTION

Presented herein is the Site Quality Assurance Project Plan (QAPP) for the sampling event to be conducted at the Jewett White Lead Company Site by the Region II Removal Support Team 2 (RST 2). The Site QAPP has been developed at the request of the U.S. Environmental Protection Agency (EPA) in accordance with the RST 2 generic Quality Assurance Project Plan (QAPP).

This plan is based on information currently available and may be modified on-site in light of field screening results and other acquired information. All deviations from the QAPP will be noted in the Sampling Trip Report.

2. PROJECT DESCRIPTION

The Jewett White Lead Company Site is located at 2000 Richmond Terrace in Staten Island, New York (Refer to Figure 1, Site Location Map). The Site was formerly used by Jewett and Sons White Lead Company to manufacture white lead during the period of 1839 to 1898. National Lead Industries purchased the business and operated at the location for several decades. Between 1949 and 1990, various businesses operated at the location including Sedutto's Ice Cream factory. Currently, the property is fenced and vacant. It was recently used to store construction materials for a nearby water main project. Soil samples collected from three test pits by the current owner of the property in October 2008 revealed lead concentrations as high as 14,430 mg/kg at 0–15 inches and 42,500 mg/kg at 15-30 inches.

RST 2 has been tasked to install test pits for sampling and observation purposes. EPA-DESA personnel will be collecting and analyzing soil samples. Soil samples will be collected from 0-3 inches, 12 inches, 24 inches and 36 inches below grade. RST 2 will provide a backhoe and operator to install estimated 15 – 20 test pits to a maximum depth of four feet below grade. RST 2 will provide for perimeter air sampling (estimated four locations) and for personnel monitoring for the backhoe operator and one RST 2 member. The analytical parameter for the air sampling and personnel monitoring will be lead. RST 2 will also collect a sample of wash water generated from the decontamination of the backhoe bucket and tires in order to classify the wash water for waste disposal.

3. PROJECT ORGANIZATION AND RESPONSIBILITIES

The EPA On-Scene Coordinator (OSC), Nick Magriples, will provide overall direction to the staff concerning project sampling needs, objectives, and schedule. The Site Project Manager (SPM), Gary Boyer, will be the primary point of contact with the OSC. The SPM is responsible for the development and completion of the Sampling QA/QC Plan, project team organization, and supervision of all project tasks, including reporting and deliverables. The Site Project Manager will be responsible for ensuring field adherence to the Sampling QA/QC Plan and recording of any deviations.

RST 2 will transfer custody of the air and wash water samples to the laboratory for analysis. The raw analytical data from the laboratory will be provided in Excel format to RST 2 for data validation.

The following personnel will work on this project:

Personnel	**Affiliation**	**Responsibility**
Nick Magriples	USEPA	On-Scene Coordinator
Gary Boyer	RST 2	Site Project Manager, Field Coordinator, Site Health and Safety, Sample Collection

The following laboratories will provide the analyses indicated:

Lab Name/Location	**Sample Type**	**Parameters**
TBD	Air	Lead
TBD	Water	TCL-VOCs, TCL-SVOCs, TPH, TCL-PCBs, Pesticides, Cyanide, Sulfide, TAL-Metals

The turnaround time for the laboratory results will be 14 days for verbal, 21 days for written statement.

4. DATA USE OBJECTIVES, QA OBJECTIVES

In addition to the following, the data use objectives, QA objectives procedure will be conducted in accordance with Sections A7, B1, B3, and B4 of the Region II RST 2 QAPP.

The objective of the air monitoring and sampling project is to determine the concentrations of lead in the outdoor air during test pit activities. The objective of the waste classification sampling is to properly classify the decontamination wash water in the drums for off-site disposal.

The laboratory data will also be evaluated to assess potential risks to human health and the environment from exposure to hazardous substances attributable to the site.

4.1 DATA QA OBJECTIVES

The overall quality assurance (QA) objective for chemical measurement data associated with this sampling event is to provide analytical results that are legally defensible in a court of law. The

QA program will incorporate quality control (QC) procedures for field sampling, chain-of-custody, laboratory analyses, and reporting to ensure generation of sound analytical results.

The EPA On-Scene Coordinator (OSC) has specified levels of Definitive Data for air samples and Screening Data with Definitive Confirmation for water samples. Details of these QA levels follow.

4.2 QA OBJECTIVES

As delineated in the Uniform Federal Policy for Quality Assurance Project Plans, Part 2B: Quality Assurance/Quality Control Non-Time Critical QA/QC Activities, the following requirements apply to the respective QA objectives and parameters identified.

The QA protocols for a Screening Data, without confirmation have limited use, specifically for: Emergencies, Health and Safety screening using (e.g. Multi Rae, OVM, Jerome Mercury...etc.). The Field Screening Data objective sampling events are applicable to all sample matrices and include:

1. Sample Documentation (location, date and time collected, batch, etc.)

2. Description of equipment and instrumentation

3. Sample documentation in the form of field logbooks, appropriate field data sheets, and chain-of-custody (when appropriate) records and procedures for field sampling management (e.g., sample location, transport, storage, sample collection methods and shipping procedure)

4. Calibration of all monitoring and/or field-portable analytical equipment prior to collection and analyses of samples with results and/or performance check procedures/methods summarized and documented in a field, personal, and/or instrument log notebook.

5. Analyte(s) identification

6. Field or laboratory determined method detection limits (MDLs) will be recorded along with corresponding analytical sample results, where appropriate.

7. Initial and continuous instrument calibration data.

The QA protocols for a screening data with definitive confirmation QA objective sampling event are applicable to all sample matrices and include:

All QA requirements listed above and:

8. Analytical error determination (Measure the precision of the analytical method, replicate and standard laboratory QC parameters, method-specific requirements specified in the QAPP).

9. Definitive Confirmation (At least 10 percent of the screening data must be confirmed with definitive data)

The QA protocols for a definitive data QA objective sampling event are applicable to all sample matrices and include:

All QA levels requirements listed above and:

10. Collection and analysis of blind field duplicate sample

11. Field blanks (for dedicated and non-dedicated equipment), rinse blanks (for non-dedicated equipment), and

12. Matrix Spike/Matrix Spike Duplicate (MS/MSD) QC samples to provide a quantitative measure of the analytical precision and accuracy, as applicable.

Definitive identification - confirm the identification of analytes on 100% of the "critical" samples, via an EPA-approved method; provide documentation such as gas chromatograms, mass spectra, etc.

The objective of this project/event applies to the following parameters:

Table 1

Quality Assurance Objectives

QA Parameters	Matrix	Intended Use of Data	QA Objective
Lead	Air	Determine presence or absence of Lead	Definitive Data
TCL-VOCs	Water	Determine presence or absence of VOCs for waste classification	Screening Data with Definitive Confirmation
TCL-PCBs/TCL-Pesticides	Water	Determine presence or absence of PCBs/Pesticides for waste classification	Screening Data with Definitive Confirmation
Sulfide/Cyanide	Water	Determine presence or absence of Sulfide/Cyanide for waste classification	Screening Data with Definitive Confirmation
TPH	Water	Determine presence or absence of TPH for waste classification	Screening Data with Definitive Confirmation
TAL-Metals	Water	Determine presence or absence of TAL-metals for waste classification	Screening Data with Definitive Confirmation
TCL-SVOCs	Water	Determine presence or absence of SVOCs for waste classification	Screening Data with Definitive Confirmation

A Field Sampling Summary is attached in Table 2 and a QA/QC Analysis and Objectives Summary is attached in Table 3. Subsection 5.1, Sampling Design, provides information on analyses to be performed on the individual air and water samples.

Table 2
Field Sampling Summary

Analytical Parameters	Matrix	Container Size	Preservative	Holding Time[1]	Subtotal Samples	Field Blanks, Lot Blanks [2,3]	Duplicate Samples	MS/MSD Samples	Total Field Samples**
Lead	Air	0.8 µm, 37 mm 3-stage MCEF cassette	NR	None	6	1 FB, 1 LB	1	NR	9
TCL-PCBs/TCL-Pesticides	Water	1 – 1 L glass amber	Cool to 4 °C	7 days to extraction, 40 days to analysis	1	NR	NR	NR	1
TCL-VOCs	Water	3 – 40 mL VOA glass vial	HCl to pH < 2 Cool to 4 °C	10 days	1	NR	NR	NR	1
TPH	Water	2- 1 L glass amber	HCl to pH < 2 Cool to 4 °C	28 days	1	NR	NR	NR	1
Sulfide	Water	500 mL glass	Cool to 4 °C NaOH to pH > 9, no head space	7 days	1	NR	NR	NR	1
Cyanide	Water	500 mL poly	Cool to 4 °C NaOH to pH > 12	14 days	1	NR	NR	NR	1
TAL-Metals	Water	1-1 L poly	HNO_3 to pH < 2 Cool to 4 °C	6 months Mercury, 28 days	1	NR	NR	NR	1
TCL-SVOCs	Water	2- 1L glass amber	Cool to 4 °C	7 days to extraction, 40 days to analysis	1	NR	NR	NR	1

[1] Holding time from date of sampling.
[2] Only required if non-dedicated sampling equipment to be used. NR - not required; dedicated sampling equipment to be used.
[3] Not required for QA-1 (screening)
** = total number of samples collected will be based on project duration.
Refer to Attachment B for a list of EPA/ERT SOPs to be used.

Table 3

QA/QC Analysis and Objectives Summary

Analytical Parameters	Matrix	Analytical Method Reference	QA/QC Quantitation Limits	QA Objective
Lead	Air	NIOSH 7300 (Elements)	As per method	Definitive
TCL-VOCs	Water	CLP SOW SOMO 1.2 or SW 846 Method 8260 B	As per method	Screening Data with Definitive Confirmation
TCL-SVOCs	Water	CLP SOW SOMO 1.2 or SW846 Method 8270 C	As per method	Screening Data with Definitive Confirmation
TCL-PCBs	Water	CLP SOW SOMO1.2 or SW 846 Method 8082	As per method	Screening Data with Definitive Confirmation
TCL-Pesticides	Water	CLP SOW SOMO1.2 or SW 846 Method 8081	As per method	Screening Data with Definitive Confirmation
TPH	Water	SW 846 Method 8015	As per method	Screening Data with Definitive Confirmation
Sulfide	Water	EPA Methods 376.1/ 376.2	As per method	Screening Data with Definitive Confirmation
Cyanide	Water	SW 846 Method 9012 A	As per method	Screening Data with Definitive Confirmation
TAL-Metals	Water	CLP SOW ILMO 5.4 or SW 846 Method 6010B/7000	As per method	Screening Data with Definitive Confirmation

5. APPROACH AND SAMPLING PROCEDURES

In addition to the following, the approach and sampling procedures will be conducted in accordance with Sections B1 and B4 of the Region II RST 2 QAPP.

RST 2 will conduct the following activities at the Jewett White Lead Company Site:

- Air sampling for Lead;
- Collection of wash water sample for waste classification analysis;
- Air monitoring for organic vapors, particulates, LEL, and combustible gases;
- Photo-documentation of the field activities;
- Maintain a detailed log of each test pit at the site;
- Provide a GPS for marking the site, identifying test pit locations, and perimeter air sampling locations.

This sampling design is based on information currently available and may be modified on-site in light of field-screening results and other acquired information. All deviations from the sampling plan will be noted in the Sampling Trip Report.

5.1 SAMPLING DESIGN

A Field Sampling Summary is attached in Table 2 and a QA/QC Analysis and Objectives Summary is attached in Table 3. Table 3 provides information on analyses to be performed on the individual samples. The field program will include the collection of air samples for lead. RST 2 will also conduct decontamination wash water sampling for waste classification from the drummed wash water. All sampling activities will be performed by the Region II RST 2, under the direction of the EPA OSC.

Air Sampling

RST 2 will conduct air sampling at up to four (4) perimeter locations during the test pit installation operations to determine the airborne concentrations of lead. One RST 2 member and the backhoe operator will also be equipped with personnel monitoring pumps to determine concentrations for lead. The air sampling equipment will consist of the air sampling pumps, collection media and the dry-cell calibrator. These perimeter sampling locations will be determined in the field. All sampling activities will be performed by the Region II RST 2, under the direction of the EPA OSC.

Air samples for lead will be collected using a 37 mm, 0.8 μm MCEF cassette that will be dedicated to its location. Air will be drawn through the filter media using an SKC PCXR8 programmable pump. The pump will be calibrated before and after each sampling event using a BIOS dry cell calibrator. A minimum flow rate of 2 Liters per minute (L/min) for a period of 8 hours will be used for each lead sample (Refer to Attachment B for the NIOSH and EPA/ERT SOPs). Once the sampling period is completed, the flow rate will be checked again. The duration of the sampling period and the flow rate will be entered onto the Air Sampling Worksheet. The total volume of air will be calculated and entered onto the worksheet and also onto the chain of custody. If the sample pump fails to run for the pre-selected period of time, this will be noted on the air sampling worksheet.

Quality Assurance/Quality Control (QA/QC) samples will include the submission of one field blank per shipment and one lot blank per lot.

RST 2 will generate a chain of custody using Scribe® sample management software for each shipment of samples. The air samples will be relinquished to the laboratory under chain-of-custody for analysis. Air samples for lead will be analyzed following NIOSH Method 7300.

Water Sampling

The sample for TPH analysis will be collected first directly from the surface of the decontamination wash water drums using the wide mouth, glass jar that will be used as the sample container. The other wash water samples will be collected from the decontamination wash water drums with a drum thief/COLIWASA and placed directly into sample containers.

RST 2 will generate a chain of custody using FORMS II Lite® or Scribe® sample management software for the water sample. The water sample will be relinquished under chain-of-custody to the laboratory for analysis for PCBs, TPH, VOCs, SVOCs, sulfide, cyanide, pesticides, and TAL-Metals. The laboratory analysis will be used for waste classification for disposal of the wash water.

Organic vapor air monitoring will be performed during the sampling operations including the soil investigation activities.

5.2 SCHEDULE OF ACTIVITIES

Proposed Start Date	Activity	End Date
December 16, 2008	Air sampling, Water sampling	December 18, 2008

5.3 SAMPLING EQUIPMENT

Air samples will be collected utilizing SKC Model 224-PCXR8 sample pumps. Air samples for lead will be collected using a 37 mm, 0.8 μm MCEF cassette. Pump flow rates will be measured (calibrated) before and after sample collection utilizing a BIOS® Dry-Cell calibrator.

Wash water samples will be collected with a dedicated, new drum thief/COLIWASA. The drum thief/coliwasa will be used to collect samples directly from the 55 gallon drums of wash water and transfer samples into the appropriate sample containers for laboratory analysis.

5.4 SAMPLE IDENTIFICATION SYSTEM

Each sample collected by Region II RST 2 will be designated by a code that will identify the site. The code will be a site-specific project tracking number. The code for the Jewett White Lead Company Site is JW. The media type will follow the site code. A hyphen will separate the site code and media type. Specific media types are as follows:

JW-LD - Lead/Air
JW-FB - Field Blank/Air
JW-LB - Lot Blank/Air
JW-W - Wash Water

After the media type, the sequential sample numbers will be listed; sample numbers will be identified as to their location on the site and/or the location on the x and y coordinates of the sampling grid. A duplicate sample will be identified in the same manner as other samples and will be distinguished and documented in the field logbook. A GPS will be used to electronically document test pit locations and air sample points.

5.5 STANDARD OPERATING PROCEDURES (SOPs)

5.5.1 Sample Documentation

All sample documents will be completed legibly, in ink. Any corrections or revisions will be made by lining through the incorrect entry and by initialing the error.

Field Logbook

The field logbook is essentially a descriptive notebook detailing site activities and observations so that an accurate account of field procedures can be reconstructed in the writer's absence. All entries will be dated and signed by the individuals making the entries, and should include (at a minimum) the following:

1. Site name and project number
2. Name(s) of personnel on-site
3. Dates and times of all entries (military time preferred)
4. Descriptions of all site activities, site entry and exit times
5. Noteworthy events and discussions
6. Weather conditions
7. Site observations

8. Sample and sample location identification and description*
9. Subcontractor information and names of on-site personnel
10. Date and time of sample collections, along with chain of custody information
11. Record of photographs
12. Site sketches

* The description of the sample location will be noted in such a manner as to allow the reader to reproduce the location in the field at a later date.

<u>Sample Labels</u>

Sample labels will clearly identify the particular sample, and should include the following:

1. Site/project number.
2. Sample identification number.
3. Sample collection date and time.
4. Designation of sample (grab or composite).
5. Sample preservation.
6. Analytical parameters.
7. Name of sampler.

Sample labels will be written in indelible ink and securely affixed to the sample container. Tie-on labels can be used if properly secured.

<u>Custody Seals</u>

Custody seals demonstrate that a sample container has not been tampered with or opened. The individual in possession of the sample(s) will sign and date the seal, affixing it in such a manner that the container cannot be opened without breaking the seal. The name of this individual, along with a description of the sample packaging, will be noted in the field logbook.

5.5.2 Sampling SOPs

The following sampling SOPs (Refer to Attachment B) will be used for this project:

EPA/ERT SOP # 2001 - General Field Sampling Guidelines;
EPA/ERT SOP # 2008 - General Air Sampling Guidelines;
EPA/ERT SOP # 2119 - Air Sampling for Metals (NIOSH Method 7300, Elements);

5.5.3 Sample Handling and Shipment

Each of the sample containers will be sealed and labeled according to the following protocol. Caps will be secured with custody seals. Bottle labels will contain all required information including site/project code and sample number, time and date of collection, analyses requested, and preservative used. Sealed bottles will be placed in large metal or plastic coolers, and padded with an absorbent material such as vermiculite. However, vermiculite will not be used to pack air samples. All packaging will conform to IATA transportation regulations for overnight carriers.

All sample documents will be sealed in a plastic bag and affixed to the underside of each cooler lid. The lid will be sealed and affixed on at least two sides with custody seals so that any sign of tampering is easily visible.

5.6 SAMPLE CONTAINERS

All sample containers will meet the QA/QC specifications in OSWER Directive 9240.0-05A, "Specifications and Guidance for Contaminant Free Sample Containers."

5.7 DISPOSAL OF PPE AND CONTAMINATED SAMPLING MATERIALS

All used PPE and disposable sampling equipment will be cleaned of gross contamination and bagged and disposed of appropriately.

6. SAMPLE CUSTODY

In addition to the following, the sample custody procedure will be conducted in accordance with Section B2 of the Region II RST 2 QAPP.

A chain-of-custody record will be prepared using Scribe® sample management software, and will be maintained from the time the sample is taken to its final deposition. Every transfer of custody must be noted and signed for, and a copy of this record kept by each individual who has signed. When samples (or groups of samples) are not under direct control of the individual responsible for them, they must be stored in a locked container sealed with a custody seal. Specific information regarding custody of the samples projected to be collected on the weekend will be noted in the field logbook.

The chain-of-custody record should include (at minimum) the following:

1. Sample identification number
2. Sample information
3. Sample location
4. Sample date
5. Name(s) and signature(s) of sampler(s)
6. Signature(s) of any individual(s) with custody of samples

A separate chain-of-custody form must accompany each cooler for each daily shipment. The chain-of-custody form must address all samples in that cooler, but not address samples in any other cooler. This practice maintains the chain-of-custody for all samples in case of mis-shipment.

7. FIELD INSTRUMENT CALIBRATION AND PREVENTIVE MAINTENANCE

In addition to the following, the field instrument and preventative maintenance procedure will be conducted in accordance with Section B5 of the Region II RST 2 QAPP.

The sampling team is responsible for ensuring that a calibration/maintenance log will be brought into the field and maintained for each measuring device. Each log will include at a minimum, where applicable:

- Name of device and/or instrument calibrated.
- Device/instrument serial and/or ID number.
- Frequency of calibration.
- Date of calibration.
- Results of calibration.
- Name of person performing the calibration.
- Identification of the calibrant.

Equipment to be used each day will be calibrated prior to the commencement of daily activities.

8. ANALYTICAL METHODS

Analytical methods to be utilized in the analyses of samples collected during this sampling event are detailed in Table 3.

9. DATA REDUCTION, VALIDATION, AND REPORTING

In addition to the following, the data reduction, validation, and reporting procedure will be conducted in accordance with Section D1 of the Region II RST 2 QAPP.

9.1 DELIVERABLES

The RST 2 SPM, Gary Boyer, will maintain contact with the EPA OSC, Nick Magriples, to keep him informed about the technical and financial progress of this project. This communication will commence with the issuance of the work assignment and project scoping meeting. Activities under this project will be reported in brief reports and other deliverables (e.g., analytical reports, final reports) described herein. Activities will also be summarized in appropriate format for inclusion in monthly and annual reports.

The following deliverables will be provided under this project:

Brief Report

A brief (1-2 pages) report will be prepared to document site activities, including test pit logs and air monitoring results. The brief report will be prepared within 2 weeks of the last day of each sampling mobilization. Information will be provided on time of major events, dates, and personnel on-site (including affiliations). The brief report will also include maps depicting sampling locations and weather conditions during the sampling period.

Maps/Figures

Maps depicting site layout and sample locations will be included in the brief report, as appropriate.

Data Review

A review of the data generated under this plan will be undertaken. The assessment of data acceptability or usability will be provided separately, or as part of the analytical report.

9.2 DATA VALIDATION

Screening data and Definitive data with detection limits need only be evaluated for calibration and detection limits criterion.

Data generated under this QA/QC Sampling Plan will be evaluated according to **guidance in the Uniform Federal Policy for Implementing Environmental Quality Systems: Evaluating, Assessing and Documenting Environmental data Collection and Use Programs Part 1: UFP-QAPP (EPA-505-B-04-900A, March 2005); Part 2B: Quality Assurance/Quality Control Compendium: Minimum QA/QC Activities (EPA-505-B-04-900B, March 2005); the CLP National Functional Guidelines for Organic and Inorganic Data Review and the Region 2 Data Validation SOPs:**

Laboratory analytical results will be assessed by the data reviewer for compliance with required precision, accuracy, completeness, representativeness, and sensitivity.

10. FIELD QUALITY CONTROL CHECKS AND FREQUENCY

In addition to the following, the field quality control checks and frequency procedure will be conducted in accordance with Section B6 of the Region II RST 2 QAPP.

This section details the QA/QC requirements for field activities performed during the sampling effort.

QA/QC samples for air sampling will include the collection of one field duplicate sample at a ratio of 1 per 20 samples (for Definitive data) and also include the submission of one lot blank per lot and one field blank per shipment.

One temperature blank sample will be included in each shipped cooler to verify that the soil samples were maintained at 4 $\pm$ 2°C from the time they were placed in the cooler to their arrival at the laboratory. The temperature blank will be prepared by filling a sample container with unpreserved potable or distilled water. The container will be labeled "Temperature Blank" and dated. The receiving laboratory will establish and record the temperature of the blank on the chain-of-custody form immediately upon receipt, prior to inventory and refrigeration.

11. SYSTEM AUDITS

In addition to the following, the system audit procedure will be conducted in accordance with Section C1 of the Region II RST 2 QAPP.

The Field QA/QC Officer will observe sampling operations and review subsequent analytical results to ensure compliance with the QA/QC requirements of the project/sampling event.

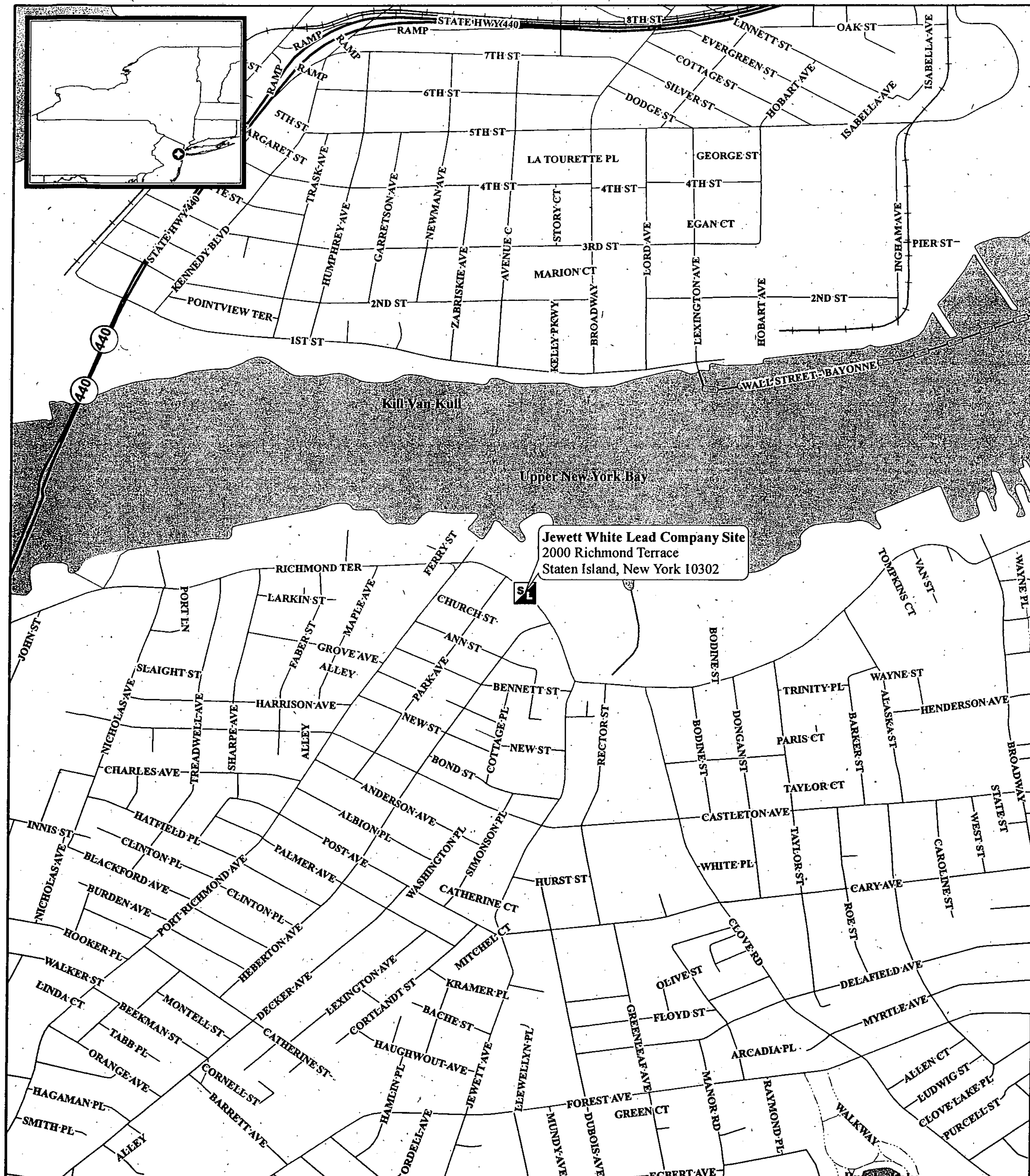
12. CORRECTIVE ACTION

In addition to the following, the corrective action procedure will be conducted in accordance with Section C1 of the Region II RST 2 QAPP.

All provisions will be taken in the field and laboratory to ensure that any problems that may develop will be dealt with as quickly as possible to ensure the continuity of the project/sampling events. Any deviations from this sampling plan will be noted in the final report.

ATTACHMENT A

SITE MAPS



Legend

S/L Site Location

N

0 0.05 0.1 0.2 0.3 0.4 Miles

WESTON SOLUTIONS Weston Solutions, Inc. Northeast Division

In Association With
Innovative Technical Solutions, Inc.,
Scientific and Environmental Associates, Inc
and Avatar Environmental, LLC.

DATE MODIFIED: 11/24/2008

Figure 1:
Site Location Map

JEWITT WHITE LEAD COMPANY SITE
STATEN ISLAND, NEW YORK

U.S. ENVIRONMENTAL PROTECTION AGENCY
REMOVAL SUPPORT TEAM 2
CONTRACT # EP-W-06-072

GIS ANALYST:	F. CAMPBELL
EPA OSC:	N. MAGRIPLES
RST SPM:	G. BOYER
FILENAME:	SITEMAP.MXD

ATTACHMENT B

EPA/ERT SAMPLING SOPS

ERT/EPA
AIR SAMPLING PROCEDURES

SOP No.	Revision No.	Date	Title
2008	0.0	11/16/94	General Air Sampling Guidelines
2119	0.0	10/07/94	Air Sampling of Metals (NIOSH Method 7300, Elements)

ERT/EPA
SAMPLING PROCEDURES

SOP No.	Revision No.	Date	Title
2001	0.0	8/11/94	General Field Sampling Guidelines (all media),

GENERAL FIELD SAMPLING GUIDELINES

SOP#: 2001
DATE: 08/11/94
REV. #: 0.0

1.0 SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to provide general field sampling guidelines that will assist REAC personnel in choosing sampling strategies, location, and frequency for proper assessment of site characteristics. This SOP is applicable to all field activities that involve sampling.

These are standard (i.e., typically applicable) operating procedures which may be varied or changed as required, dependent on site conditions, equipment limitations or limitations imposed by the procedure. In all instances, the ultimate procedures employed should be documented and associated with the final report.

Mention of trade names or commercial products does not constitute U.S. EPA endorsement or recommendation for use.

2.0 METHOD SUMMARY

Sampling is the selection of a representative portion of a larger population, universe, or body. Through examination of a sample, the characteristics of the larger body from which the sample was drawn can be inferred. In this manner, sampling can be a valuable tool for determining the presence, type, and extent of contamination by hazardous substances in the environment.

The primary objective of all sampling activities is to characterize a hazardous waste site accurately so that its impact on human health and the environment can be properly evaluated. It is only through sampling and analysis that site hazards can be measured and the job of cleanup and restoration can be accomplished effectively with minimal risk. The sampling itself must be conducted so that every sample collected retains its original physical form and chemical composition. In this way, sample integrity is insured, quality assurance standards are maintained, and the sample can accurately represent the larger body of material under investigation.

The extent to which valid inferences can be drawn from a sample depends on the degree to which the sampling effort conforms to the project's objectives. For example, as few as one sample may produce adequate, technically valid data to address the project's objectives. Meeting the project's objectives requires thorough planning of sampling activities, and implementation of the most appropriate sampling and analytical procedures. These issues will be discussed in this procedure.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

The amount of sample to be collected, and the proper sample container type (i.e., glass, plastic), chemical preservation, and storage requirements are dependent on the matrix being sampled and the parameter(s) of interest. Sample preservation, containers, handling, and storage for air and waste samples are discussed in the specific SOPs for air and waste sampling techniques.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

The nature of the object or materials being sampled may be a potential problem to the sampler. If a material is homogeneous, it will generally have a uniform composition throughout. In this case, any sample increment can be considered representative of the material. On the other hand, heterogeneous samples present problems to the sampler because of changes in the material over distance, both laterally and vertically.

Samples of hazardous materials may pose a safety threat to both field and laboratory personnel. Proper health and safety precautions should be implemented when handling this type of sample.

Environmental conditions, weather conditions, or non-target chemicals may cause problems and/or interferences when performing sampling activities or when sampling for a specific parameter. Refer to the specific SOPs for sampling techniques.

5.0 EQUIPMENT/APPARATUS

The equipment/apparatus required to collect samples must be determined on a site specific basis. Due to the wide variety of sampling equipment available, refer to the specific SOPs for sampling techniques which include lists of the equipment/apparatus required for sampling.

6.0 REAGENTS

Reagents may be utilized for preservation of samples and for decontamination of sampling equipment. The preservatives required are specified by the analysis to be performed. Decontamination solutions are specified in ERT SOP #2006, Sampling Equipment Decontamination.

7.0 PROCEDURE

7.1 Types of Samples

In relation to the media to be sampled, two basic types of samples can be considered: the environmental sample and the hazardous sample.

Environmental samples are those collected from streams, ponds, lakes, wells, and are off-site samples that are not expected to be contaminated with hazardous materials. They usually do not require the special handling procedures typically used for concentrated wastes. However, in certain instances, environmental samples can contain elevated concentrations of pollutants and in such cases would have to be handled as hazardous samples.

Hazardous or concentrated samples are those collected from drums, tanks, lagoons, pits, waste piles, fresh spills, or areas previously identified as contaminated, and require special handling procedures because of their potential toxicity or hazard. These samples can be further subdivided based on their degree of hazard; however, care should be taken when handling and shipping any wastes believed to be concentrated regardless of the degree.

The importance of making the distinction between environmental and hazardous samples is two-fold:

(1) Personnel safety requirements: Any sample thought to contain enough hazardous materials to pose a safety threat should be designated as hazardous and handled in a manner which ensures the safety of both field and laboratory personnel.

(2) Transportation requirements: Hazardous samples must be packaged, labeled, and shipped according to the International Air Transport Association (IATA) Dangerous Goods Regulations or Department of Transportation (DOT) regulations and U.S. EPA guidelines.

7.2 Sample Collection Techniques

In general, two basic types of sample collection techniques are recognized, both of which can be used for either environmental or hazardous samples.

Grab Samples

A grab sample is defined as a discrete aliquot representative of a specific location at a given point in time. The sample is collected all at once at one particular point in the sample medium. The representativeness of such samples is defined by the nature of the materials being sampled. In general, as sources vary over time and distance, the representativeness of grab samples will decrease.

Composite Samples

Composites are nondiscrete samples composed of more than one specific aliquot collected at various sampling locations and/or different points in time. Analysis of this type of sample produces an average value and can in certain instances be used as an alternative to analyzing a number of individual grab samples and calculating an average value. It should be noted, however, that compositing can mask problems by diluting isolated concentrations of some hazardous compounds below detection limits.

Compositing is often used for environmental samples and may be used for hazardous samples under certain conditions. For example, compositing of hazardous waste is often performed after compatibility tests have been completed to determine an average value over a number of different locations (group of drums). This procedure generates data that can be useful by providing an average concentration within a number of units, can serve to keep analytical costs down, and can provide information useful to transporters and waste disposal operations.

For sampling situations involving hazardous wastes, grab sampling techniques are generally preferred because grab sampling minimizes the amount of time sampling personnel must be in contact with the wastes, reduces risks associated with compositing unknowns, and eliminates chemical changes that might occur due to compositing.

7.3 Types of Sampling Strategies

The number of samples that should be collected and analyzed depends on the objective of the investigation. There are three basic sampling strategies: random, systematic, and judgmental sampling.

Random sampling involves collection of samples in a nonsystematic fashion from the entire site or a specific portion of a site. Systematic sampling involves collection of samples based on a grid or a pattern which has been previously established. When judgmental sampling is performed, samples are collected only from the portion(s) of the site most likely to be contaminated. Often, a combination of these strategies is the best approach depending on the type of the suspected/known contamination, the uniformity and size of the site, the level/type of information desired, etc.

7.4 QA Work Plans (QAWP)

A QAWP is required when it becomes evident that a field investigation is necessary. It should be initiated in conjunction with, or immediately following, notification of the field investigation. This plan should be clear and concise and should detail the following basic components, with regard to sampling activities:

C Objective and purpose of the investigation.
C Basis upon which data will be evaluated.
C Information known about the site including location, type and size of the facility, and length of operations/abandonment.
C Type and volume of contaminated material, contaminants of concern (including concentration), and basis of the information/data.
C Technical approach including media/matrix to be sampled, sampling equipment to be used, sample equipment decontamination (if necessary), sampling design and rationale, and SOPs or description of the procedure to be implemented.
C Project management and reporting, schedule, project organization and responsibilities, manpower and cost projections, and required deliverables.
C QA objectives and protocols including tables summarizing field sampling and QA/QC analysis and objectives.

Note that this list of QAWP components is not all-inclusive and that additional elements may be added or altered depending on the specific requirements of the field investigation. It should also be recognized that although a detailed QAWP is quite important, it may be impractical in some instances. Emergency responses and accidental spills are prime examples of such instances where time might prohibit the development of site-specific QAWPs prior to field activities. In such cases, investigators would have to rely on general guidelines and personal judgment, and the sampling or response plans might simply be a strategy based on preliminary information and finalized on site. In any event, a plan of action should be developed, no matter how concise or informal, to aid investigators in maintaining a logical and consistent order to the implementation of their task.

7.5 Legal Implications

The data derived from sampling activities are often introduced as critical evidence during litigation of a hazardous waste site cleanup. Legal issues in which sampling data are important may include cleanup cost recovery, identification of pollution sources and responsible parties, and technical validation of remedial design methodologies. Because of the potential for involvement in legal actions, strict adherence to technical and administrative SOPs is essential during both the development and implementation of sampling activities.

Technically valid sampling begins with thorough planning and continues through the sample collection and analytical procedures. Administrative requirements involve thorough, accurate documentation of all sampling activities. Documentation requirements include maintenance of a chain of custody, as well as accurate records of field activities and analytical instructions. Failure to observe these procedures fully and consistently may result in data that are questionable, invalid and non-defensible in court, and the consequent loss of enforcement proceedings.

8.0 CALCULATIONS

Refer to the specific SOPs for any calculations which are associated with sampling techniques.

9.0 QUALITY ASSURANCE/ QUALITY CONTROL

Refer to the specific SOPs for the type and frequency of QA/QC samples to be analyzed, the acceptance criteria for the QA/QC samples, and any other QA/QC activities which are associated with sampling techniques.

10.0 DATA VALIDATION

Refer to the specific SOPs for data validation activities that are associated with sampling techniques.

11.0 HEALTH AND SAFETY

When working with potentially hazardous materials, follow U.S. EPA, OSHA, and corporate health and safety procedures.

GENERAL AIR SAMPLING GUIDELINES

SOP#: 2008
DATE: 11/16/94
REV. #: 0.0

1.0 SCOPE AND APPLICATION

This Standard Operating Procedure (SOP) provides guidance in developing and implementing sampling plans to assess the impact of hazardous waste sites on ambient air. It presents the United States Environmental Protection Agency/Environmental Response Team's (U.S. EPA/ERT's) approach to air sampling and monitoring and identifies equipment requirements. It is not within the scope of this SOP to provide a generic air sampling plan. Experience, objectives, site characteristics, and chemical characteristics will dictate sampling strategy. This SOP does not address indoor air sampling.

Two basic approaches can be used to assess ambient air (also referred to as air pathway assessments): modeling and measurements. The modeling approach initially estimates or measures the overall site emission rate(s) and pattern(s). These data are input into an appropriate air dispersion model, which predicts either the maximum or average air concentrations at selected locations or distances during the time period of concern. This overall modeling strategy is presented in the first three volumes of the Air Superfund National Technical Guidance Series on Air Pathway Assessments[1,2,3]. Specific applications of this strategy are presented in several additional Air Superfund Technical Guidance documents[4].

The measurement approach involves actually measuring the air impact at selected locations during specific time periods. These measurements can be used to document actual air impacts during specific time intervals (i.e., during cleanup operations) or to extrapolate the probable "worst case" concentrations at that and similar locations over a longer time period than was sampled.

This SOP addresses issues associated with this second assessment strategy. This SOP also discusses the U.S. EPA/ERT's monitoring instruments, air sampling kits, and approach to air sampling and monitoring at hazardous waste sites.

These are standard (i.e., typically applicable) operating procedures which may be varied or changed as required, depending on site conditions, equipment limitations, or limitations imposed by the procedure. In all instances, the ultimate procedures employed should be documented and associated with the final report.

Mention of trade names or commercial products does not constitute U.S. EPA endorsement or recommendation for use.

2.0 METHOD SUMMARY

Air monitoring is defined as the use of direct-reading instruments and other screening or monitoring equipment and techniques that provide instantaneous (real-time) data on the levels of airborne contaminants. The U.S. EPA/ERT maintains numerous monitors for real-time measurements. Examples of air monitoring equipment are hand-held photoionization detectors (PID), flame ionization detectors (FID), oxygen/combustible gas detectors, and remote optical sensors.

Air sampling is defined as those sampling and analytical techniques that require either off- or on-site laboratory analysis and therefore do not provide immediate results. Typically, air sampling occurs after use of real-time air monitoring equipment has narrowed the number of possible contaminants and has provided some qualitative measurement of contaminant concentration. Air sampling techniques are used to more accurately detect, identify and quantify specific chemical compounds relative to the majority of air monitoring technologies.

In the Superfund Removal Program, On-Scene Coordinators (OSCs) may request the U.S. EPA/ERT to conduct air monitoring and sampling during the following situations: emergency responses, site assessments, and removal activities. Each of these activities has a related air monitoring/sampling objective that is used to determine the potential hazards to workers and/or the community.

- Emergency Response

  Emergency responses are immediate responses to a release or threatened release of hazardous substances presenting an imminent danger to public health, welfare, or the environment (i.e., chemical spills, fires, or chemical process failures resulting in a controlled release of hazardous substances). Generally these situations require rapid on-site investigation and response. A major part of this investigation consists of assessing the air impact of these releases.

- Removal Site Assessment

  Removal site assessments (referred to as site assessments) are defined as any of several activities undertaken to determine the extent of contamination at a site and which help to formulate the appropriate response to a release or threatened release of hazardous substances. These activities may include a site inspection, multimedia sampling, and other data collection.

- Removal Actions

  Removal actions clean up or remove hazardous substances released into the environment. Removal actions include any activity conducted to abate, prevent, minimize, stabilize, or eliminate a threat to public health or welfare, or to the environment.

Personal risk from airborne contaminants can be determined by comparing the results of on-site monitoring and sampling to health-based action levels such as the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs) and the Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PELs). Residential risk can be determined by comparing the results of off-site monitoring or sampling to health-based action levels such as those developed by the Agency for Toxic Substance and Disease Registry (ATSDR).

The extent to which valid inferences can be drawn from air monitoring/sampling depends on the degree to which the monitoring/sampling effort conforms to the objectives of the event. Meeting the project's objectives requires thorough planning of the monitoring/sampling activities, and implementation of the most appropriate monitoring/sampling and analytical procedures. These issues will be discussed in this SOP.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

Preservation, containers, handling and storage for air samples are discussed in the specific SOPs for the technique selected. In addition, the analytical method (i.e., U.S. EPA, National Institute for Occupational Safety and Health [NIOSH], and OSHA Methods) may be consulted for storage temperature, holding times and packaging requirements. After sample collection, the sampling media (i.e., cassettes or tubes) are immediately sealed. The samples are then placed into suitable containers (i.e., whirl bags, resealable bagsor culture tubes) which are then placed into a shipping container.

Use bubble wrap or styrofoam peanuts when packing air samples for shipment. DO NOT USE VERMICULITE.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

Upwind sources can contribute to sample concentration. Natural sources, such as biological waste, can produce hydrogen sulfide and methane which may contribute to the overall contaminant level. Extraneous anthropogenic contaminants (i.e., burning of fossil fuels; emissions from vehicular traffic, especially diesel; volatile compounds from petrochemical facilities; and effluvium from smoke stacks) may also contribute. Air sampling stations should be strategically placed to identify contributing sources.

Photoreactivity or reaction of the parameters of concern may occur with nonrelated compounds [i.e., nitrogen compounds and polyaromatic hydrocarbons

(PAHs)]. Some sorbent media/samples should not be exposed to light during or after sampling due to photochemical effects (i.e., PAHs).

Various environmental factors, including humidity, temperature and pressure, also impact the air sampling methodology, collection efficiency and detection limit. Since the determination of air contaminants is specifically dependent on the collection parameters and efficiencies, the collection procedure is an integral part of the analytical method.

Detection limits depend on the contaminants being investigated and the particular site situation. It is important to know why the data are needed and how the data will be used. Care should be taken to ensure the detection limits are adequate for the intended use of the final results.

Some equipment may be sensitive to humidity and temperature extremes.

5.0 EQUIPMENT/APPARATUS

5.1 Direct Reading Instruments (Air Monitoring Instruments)

There are two general types of direct reading instruments: portable screening devices and specialized analytical instruments. Generally all these techniques involve acquiring, for a specific location or area, continuous or sequential direct air concentrations in either a real-time or semi-real-time mode. None of these instruments acquires true time-weighted average concentrations. In addition, these instruments are not capable of acquiring simultaneous concentration readings at multiple locations, although several are able to sequentially analyze samples taken remotely from different locations. The document, "Guide to Portable Instruments for Assessing Airborne Pollutants Arising from Hazardous Waste Sites[5]," provides additional information about air sampling and monitoring. The hazard levels for airborne contaminants vary. See the ACGIH TLVs and the OSHA PELs for safe working levels. Common screening devices and analytical instruments are described in Appendix A.

5.2 Air Sampling Equipment and Media/Devices

The U.S. EPA/ERT uses the following analytical methods for sampling: *NIOSH Manual of Analytical Methods*[6], *American Society for Testing and Materials (ASTM) Methods*[7], *U.S. EPA Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air*[8,9], and *OSHA Methods*[10]. Additional air sampling references include *Industrial Hygiene and Toxicology* (3rd Ed.)[11] and *Air Sampling Instruments for Evaluation of Atmospheric Contaminants*[12]. These methods typically specify equipment requirements for sampling. Since air sampling is such a diverse technology, no single method or reference is best for all applications. Common sampling equipment and media/devices are described in Appendix B.

5.3 Tools/Material and Equipment List

In addition to equipment and materials identified in Appendices A and B, the following equipment and materials may be required to conduct air sampling and monitoring at hazardous waste sites:

C Camera
C Site logbook
C Clipboard
C Chain of custody records
C Custody seals
C Air sampling worksheets
C Sample labels
C Small screwdriver set
C Aluminum foil
C Extension cords
C Glass cracker
C Multiple plug outlet
C Whirl bags or culture tubes
C Teflon tape
C Calibration devices
C Tygon and or Teflon® tubing
C Surgical gloves
C Lint-free gloves
C Ice
C Sample container

Use the following additional equipment when decontaminating glassware on site:

C Protective equipment (i.e., gloves, splash goggles, etc.)
C Appropriate solvent(s)
C Spray bottles
C Liquinox (soap)
C Paper towels

- Distilled/deionized water
- Five-gallon buckets
- Scrub brushes and bottle brushes

6.0 REAGENTS

Impinger sampling involves using reagents contained in a glass vial to absorb contaminants of concern (for example, NIOSH Method 3500 for formaldehyde uses 1% sodium bisulfite solution). Impinger solutions vary and are method-dependent.

Reagents such as acetone and hexane are required to decontaminate glassware and some air sampling equipment. Decontamination solutions are specified in the Sampling Equipment Decontamination SOP.

7.0 PROCEDURES

7.1 Air Monitoring Design

7.1.1 Initial Surveys

In general, the initial survey is considered to be a relatively rapid screening process for collecting preliminary data at hazardous waste sites. However, initial surveys may require many hours to complete and may consist of more than one entry.

Some information is generally known about the site; therefore, real-time instrumentation for specific compounds (i.e., detector tubes and electrochemical sensors) can be used to identify hot spots. Sufficient data should be obtained with real-time instruments during the initial entry to screen the site for various contaminants. When warranted, intrinsically safe or explosion-proof instruments should be used. An organic vapor analyzer (OVA) is typically used during this survey. These gross measurements may be used on a preliminary basis to (1) determine levels of personal protection, (2) establish site work zones, and (3) map candidate areas for more thorough qualitative and quantitative studies involving air sampling.

In some situations, the information obtained may be sufficient to preclude additional monitoring. Materials detected during the initial survey may call for a more comprehensive evaluation of hazards and analyses for specific compounds. Since site activities and weather conditions change, a continuous program to monitor the ambient atmosphere must be established.

7.1.2 Off-Site Monitoring

Typically, perimeter monitoring with the same instruments employed for on-site monitoring is utilized to determine site boundaries. Because air is a dynamic matrix, physical boundaries like property lines and fences do not necessarily delineate the site boundary or area influenced by a release. Whenever possible, atmospheric hazards in the areas adjacent to the on-site zone should be monitored with direct-reading instruments. Monitoring at the fenceline or at varying locations off site provides useful information regarding pollutant migration. Three to four locations downwind of the source (i.e., plume) at breathing-zone height, provide a basic fingerprint of the plume. Negative instrument readings off site should not be interpreted as the complete absence of airborne toxic substances; rather, they should be considered another piece of information to assist in the preliminary evaluation. The interpretation of negative readings is instrument-dependent. The lack of instrument readings off site should not be interpreted as the complete absence of all airborne toxic substances; rather, it is possible that the particular compound or class of compounds to which the monitoring instrument responds is not present or that the concentration of the compound(s) is below the instrument's detection limit.

7.2 Air Sampling Design

7.2.1 Sampling Plan Design

The goal of air sampling is to accurately assess the impact of a contaminant source(s) on ambient air quality. This impact is expressed in terms of overall average and/or maximum air concentrations for the time period of concern and may be affected by the transport and release of pollutants from both on- and off-site sources. The location of these sources must be taken into account as they impact the selection of sampling locations. Unlike soil and groundwater concentrations, air concentrations at points of interest can easily vary by orders of magnitude over the period of concern. This variability plays a major role in designing an air sampling plan.

Downwind air concentration is determined by the amount of material being released from the site into the air (the emission rate) and by the degree that the contamination is diluted as it is transported. Local meteorology and topography govern downwind dilution. Contaminant emission rates can also be heavily influenced by on-site meteorology and on-site activities. All of these concerns must be incorporated into an air sampling plan.

A sampling strategy can be simple or complex, depending on the sampling program objectives. Programs involving characterization of the pollutant contribution from a single point source tend to be simple, whereas sampling programs investigating fate and transport characteristics of components from diverse sources require a more complex sampling strategy. In addition, resource constraints may affect the complexity of the sampling design.

An optimal sampling strategy accounts for the following site parameters:

- Location of stationary as well as mobile sources
- Analytes of concern
- Analytical detection limit to be achieved
- Rate of release and transport of pollutants from sources
- Availability of space and utilities for operating sampling equipment
- Meteorological monitoring data
- Meteorological conditions in which sampling is to be conducted

The sampling strategy typically requires that the concentration of contaminants at the source or area of concern as well as background contributions be quantified. It is important to establish background levels of contaminants in order to develop a reference point from which to evaluate the source data. Field blanks and lot blanks, as well as various other types of QA/QC samples, can be utilized to determine other sources. The impact of extraneous sources on sampling results can frequently be accounted for by placing samplers upwind, downwind and crosswind from the subject source. The analytical data from these different sampling locations may be compared to determine statistical differences.

7.2.2 Sampling Objectives

The objectives of the sampling must be determined prior to developing the sampling plan. Does the sampling plan verify adequate levels of protection for on-site personnel, or address potential off-site impacts associated with the site or with site activities? In addition, the assumptions associated with the sampling program must be defined. These assumptions include whether the sampling is to take place under "typical," "worst case," or "one-time" conditions. If the conditions present at the time of sampling are different from those assumed during the development of the sampling plan, then quality of the data collected may be affected. The following definitions have been established:

- Typical: routine daily sampling or routine scheduled sampling at pre-established locations.

- Worst case: sampling conducted under the worst meteorological and/or site conditions which would result in elevated ambient concentrations.

- One-time: only one chance is given to collect a sample without regard to time or conditions.

Qualitative data acquired under these conditions are usually applicable only to the time period during which the data were collected and may not provide accurate information to be used in estimating the magnitude of an air impact during other periods or over a long time interval.

The sampling objectives also dictate the detection limits. Sampling methods for airborne contaminants will depend upon the nature and state (solid, liquid or gas) of the contaminant. Gases and vapors may be collected in aqueous media or adsorbents, in molecular sieves, or in suitable containers. Particulates are collected by filters or impactors. The volume of sample to be collected is dependent upon an estimate of the contaminant concentration in the air, the sensitivity of the analytical method, and the standard or desired detection limit. A sufficient amount of sample must be collected to achieve the desired detection limit without interference from other contaminants. In addition, the selected method must be able to detect the target compound(s).

7.2.3 Location and Number of Individual Sampling Points

Choose the number and location of sampling points according to the variability, or sensitivity, of the sampling and analytical methods being utilized, the variability of contaminant concentration over time at the site, the level of precision required and costlimitations. In addition, determine the number of locations and placement of samplers by considering the nature of the response, local terrain, meteorological conditions, location of the site (with respect to other conflicting background sources), size of the site, and the number, size, and relative proximity of separate on-site emission sources and upwind sources. The following are several considerations for sampler placement:

- Location of potential on-site emission sources, as identified from the review of site background information or from preliminary on-site inspections.

- Location of potential off-site emission sources upwind of the sampling location(s). Review local wind patterns to determine the location of off-site sources relative to wind direction.

- Topographic features that affect the dispersion and transport of airborne toxic constituents.

Avoid natural obstructions when choosing air sampling station locations, and account for channelization around those obstructions.

- Large water bodies, which affect atmospheric stability and the dispersion of air contaminants.

- Roadways (dirt or paved), which may generate dust that could mask site contaminants.

- Vegetation, such as trees and shrubs, which stabilizes soil and retards subsurface contaminants from becoming airborne. It also affects air flow and scrubs some contaminants from the air. Sometimes thick vegetation can make an otherwise ideal air monitoring location inaccessible.

Consider the duration of sampling activities when choosing the location and number of samples to be collected. For example, if the sampling period is limited to a few hours, one or two upwind and several downwind samples would typically be adequate, especially around major emission sources.

A short-term monitoring program ranges from several days to a few weeks and generally includes gathering data for site assessments, removal actions, and source determination data (for further modeling). Activities involved in a short-term sampling strategy must make the most of the limited possibilities for data collection. Consider moving upwind/downwind locations daily based on National Oceanic and Atmospheric Administration (NOAA) weather forecasts. Weather monitoring becomes critical where complex terrain and local meteorological effects frequently change wind direction. Often, a number of alternatives can fulfill the same objective.

Prevailing winds running the length of a valley usually require a minimum number of sampler locations; however, a complex valley may require more sampler locations to account for the wide variety of winds. Ocean/lake effects may require a radical plan to collect enough samples to reach a low detection limit. Two sets of samplers may be placed next to each other: one set would be activated during the sea breeze while the other set is turned off, and vice versa when there is no sea breeze. After the sampling event, the respective upwind and downwind samples would be combined. Another alternative for sampling near a large body of water may be to use automatic, wind-vector-operated samplers, which turn the sampler on only when the wind comes from a specified vector. At sites located on hillsides, wind will move down a valley and produce an upward fetch at the same time. Sampling locations may have to ring the site to measure the wind's impact.

Off-site sources may affect on-site monitoring. In this case, on-site meteorological data, concurrent with sampling data, is essential to interpreting the acquired data. Also, additional upwind sampling sites may be needed to fully characterize ambient background contaminant levels. Multiple off-site sources may require several monitoring locations, but if the sources are at a sufficient distance, only one monitoring location is needed.

Topography and weather are not the only factors in sampler location; the sampling sites must be secure from vandals and mishap. Secure all sampling locations to maintain chain of custody, and to prevent tampering with samples or loss of sampling units. High-volume sampling methods often require the use of 110 VAC electric power. When portable generators are used, the power quality may affect sampler operation. Also, be aware that the generators themselves could be a potential pollution source if their placement is not carefully considered.

Air quality dispersion models can be used to place samplers. The models incorporate source information, surrounding topography, and meteorological data to predict the general distance and directions of maximum ambient concentrations. Modeling results should be used to select sampling locations in areas of maximum pollutant concentrations.

7.2.4 Time, Duration and Frequency of Sampling Events

After choosing appropriate sampling or monitoring locations, determine the sampling frequency and the number of samples to be collected. The time of day, duration and frequency of sampling events is governed by:

- The effects of site activities and meteorology on emission rates
- The diurnal effect of the meteorology on downwind dispersion
- The time period(s) of concern as defined by the objective
- The variability in the impact from other non-site-related sources
- If defined, the degree of confidence needed for either the mean or maximum downwind concentrations observed
- The precision requirements for single measurements
- Cost and other logistical considerations

The duration of the removal action and the number of hours per day that site work is conducted determine the time, duration, and frequency of samples. Short-term sampling programs may require daily sampling, while long-term programs may require 24-hour sampling every sixth or twelfth day. If the site will be undergoing removal activities 24 hours a day, continuous air sampling may be warranted. However, if the site activities will be conducted for only eight hours a day, and there are no emissions likely to occur during the remaining 16 hours, then sampling would be appropriate prior to the start of daily activities, would continue during operations, and end at the conclusion of the daily activities. An off-peak sample collection can ensure that emissions are not persisting after the conclusion of daily cleanup activities. For some sites, emissions are still a factor several hours after daily site activities have been completed. Because of the typically decreased downwind dispersion in the evening, higher downwind concentrations than were present during daytime site activities may be detected. For sites where this is possible, the sampling duration needs to be lengthened accordingly.

Sampling duration and flow rate dictate the volume of air collected, and to a major degree, the detection limit. The analytical method selected will provide a reference to flow rate and volume. Flow rates are limited to the capacity of the pumps being employed and the contact time required by the collection media.

The duration or period of air sampling is commonly divided into two categories (1) samples collected over a brief time period are referred to as "instantaneous" or "grab" samples and are usually collected in less than five minutes and (2) average or integrated samples are collected over a significantly longer period of time. Integrated samples provide an average concentration over the entire sampling period. Integrated samples are not suited to determining cyclical releases of contaminants because periodic or cyclical events are averaged out by the proportionally long sampling duration.

Air quality dispersion models can predict the maximum air contaminant concentration expected from a source. The meteorological and site conditions expected to cause the highest concentration are known as worst-case conditions and can be identified by analyzing the modeling results. Depending upon the objective, one may sample when the model predicts worst-case conditions will exist.

7.2.5 Meteorological and Physical/Chemical Considerations

A meteorological monitoring program is an integral part of site monitoring activities. Meteorological data, which define local terrain impacts on air flow paths, are needed to interpret air concentration data. Meteorological data may be available from an existing station located near the site (i.e., at a local airport), otherwise a station should be set up at the site. This data will document the degree that samples actually were downwind and verify whether other worst-case assumptions were met. Meteorological parameters to be monitored are, at a minimum, wind speed, wind direction, and sigma theta (which is the horizontal wind direction standard deviation and an indicator of atmospheric stability). The remaining parameters primarily affect the amount of a contaminant available in the air.

- Wind Speed

  When the contaminant of concern is a particulate, wind speed is critical in determining whether the particulate will become airborne, the quantity of the particulate that becomes airborne, and the distance the particulate will travel from the source. Wind speed also contributes to the volatilization of contaminants from liquid sources.

- Wind Direction

  Wind direction highly influences the path of airborne contaminants. In addition, variations in wind direction increase the dispersion of pollutants from a given source.

- Atmospheric Stability

  Atmospheric stability refers to the degree to which the atmosphere tends to dampen vertical and horizontal motion. Stable atmospheric conditions (i.e., evenings) result in low dispersion, and unstable atmospheric conditions (i.e., hot sunny days) result in higher dispersion.

- Temperature

  Higher temperatures increase the rate of volatilization of organic and some inorganic compounds and affect the initial rise of gaseous or vapor contaminants. Therefore, worst-case emission of volatiles and semivolatiles occurs at the hottest time of day, or on the hottest day.

- Humidity

  High humidity affects water-soluble chemicals and particulates. Humid conditions may dictate the sampling media used to collect the air sample, or limit the volume of air sampled and thereby increase the detection limit.

- Atmospheric Pressure

  Migration of landfill gases through the landfill surface and through surrounding soils are governed by changes in atmospheric pressure. Atmospheric pressure will influence upward migration of gaseous contaminants from shallow aquifers into the basements of overlying structures.

In many cases, the transport and dispersion of air pollutants is complicated by local meteorology. Normal diurnal variations (i.e., temperature inversions) affect dispersion of airborne contaminants. Terrain features can enhance or create air inversions and can also influence the path and speed of air flow, complicating transport and dispersion patterns.

The chemical characteristics of a contaminant (i.e., molecular weight, physical state, vapor pressure, aerodynamic size, temperature, reactive compounds, and photodegradation) affects its behavior and can influence the method used to sample and analyze it.

8.0 CALCULATIONS

Volume is obtained by multiplying the sample time in minutes by the flow rate. Sample volume should be indicated on the chain of custody record. Adjustments for temperature and pressure differences may be required.

Results are usually provided in parts per million (ppm), parts per billion (ppb), milligrams per cubic meter (mg/m^3) or micrograms per cubic meter ($\mu g/m^3$).

Refer to the analytical method or regulatory guidelines for other applicable calculations.

9.0 QUALITY ASSURANCE/ QUALITY CONTROL

The manufacturer's instructions should be reviewed prior to instrument use. Instruments must be utilized in accordance with manufacturer's instructions. Equipment checkout and calibration activities must occur prior to and after monitoring and sampling and must be documented.

9.1 QA/QC Samples

QA/QC samples provide information on the variability and usability of environmental sample results. Various QA/QC samples may be collected to detect error. QA/QC samples are submitted with the field samples for analysis to aid in identifying the origin of analytical discrepancies; then a determination can be made as to how the analytical results should be used. Collocated samples, background samples, field blanks, and lot blanks are the most commonly collected QA/QC field samples. Performance evaluation (PE) samples and matrix spikes provide additional measures of data QA/QC control. QA/QC results may suggest the need for modifying sample collection, preparation, handling, or analytical procedures if the resultant data do not meet site-specific QA or data quality objectives.

9.2 Sample Documentation

All sample and monitoring activities should be documented legibly, in ink. Any corrections or revisions should be made by lining through the incorrect entry and by initialing the error. All samples must be recorded on an Air Sampling Worksheet. A chain of custody record must be maintained from the time a sample is taken to the final deposition of the sample. Custody seals demonstrate that a sample container has not been opened or tampered with during transport or storage of samples.

10.0 DATA VALIDATION

Results for QA/QC samples should be evaluated for contamination. This information should be utilized to qualify the environmental sample results accordingly with data quality objectives.

11.0 HEALTH AND SAFETY

Personal protection equipment (PPE) requirements identified in federal and/or state regulations and 29 Code of Federal Regulations (CFR) 1910.120 for hazardous waste site work must be followed.

The majority of physical precautions involved in air sampling are related to the contaminant sampled. Attention should be given when sampling in potentially explosive, flammable or acidic atmospheres. On rare occasions, the collection media may be hazardous; for example, in the instance where an acidic or basic solution is utilized in an impinger.

When working with potentially hazardous materials, follow U.S. EPA, OSHA and corporate health and safety procedures.

12.0 REFERENCES

(1) U.S. EPA. *Air Superfund National Technical Guidance Series. Volume I. Application of Air Pathway Analyses for Superfund Activities.* EPA/450/1-89/001.

(2) U.S. EPA. *Air Superfund National Technical Guidance Series. Volume II. Estimation of Baseline Air Emissions at Superfund Sites.* EPA/450/1-89/002.

(3) U.S. EPA. *Air Superfund National Technical Guidance Series. Volume III. Estimations of Air Emissions from Cleanup Activities at Superfund Sites.* EPA/450/1-89/003.

(4) U.S. EPA. *Air Superfund National Technical Guidance Series. Volume IV. Procedures for Dispersion Air Modeling and Air Monitoring for Superfund Air Pathway Analysis.* EPA/450/1-89/004.

(5) *Guide to Portable Instruments for Assessing Airborne Pollutants Arising from Hazardous Wastes,* International Organization of Legal Metrology (OIML) U.S. National Working Group (NWG) for OIML. American Conference of Governmental Industrial Hygienists, Cincinnati, OH.

(6) NIOSH. *Manual of Analytical Methods, Second Edition. Volumes 1-7.* U.S. Department of Health and Human Services Publication No. 84-100.

NIOSH. *Manual of Analytical Methods,* February 1984. U.S. Department of Health and Human Services Publication No. 84-100.

(7) ASTM. 1990. *Annual Book of Standards. Volume 11.03.*

(8) Riggin, R.M. *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air.* EPA/600/4-84/041.

(9) Winberry, W.T. *Supplement to U.S. EPA/600/4-84/041: Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air.* EPA/600/4-87/006.

(10) OSHA. *Analytical Methods Manual, Second Edition. Part 1, Organic Substances,* January 1990. *Part 2, Inorganic Substances* August 1991.

(11) Patty, F.A., *Industrial Hygiene and Toxicology, Third Edition.* John Wiley and Sons, Inc., New York, NY.

(12) *Air Sampling Instruments for Evaluation of Atmospheric Contaminants, Seventh Edition.* 1989. American Conference of Governmental Industrial Hygienists, Cincinnati, OH

BIBLIOGRAPHY

Removal Program Representative Sampling Guidance, Volume 2: Air, Environmental Response Branch, Emergency Response Division, Office of Emergency and Remedial Response, Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, April 1992, Interim Final.

APPENDIX A

Portable Screening Devices and Specialized Analytical Instruments

PORTABLE SCREENING DEVICES

Where possible, a datalogger should be used to minimize the length of time required for site personnel to be in a potentially contaminated area. Datalogger cable is available from manufacturers for linear output instruments and some nonlinear output instruments. U.S. EPA ERT/REAC has output cables for organic vapor analyzers (i.e., HNU and OVA), toxic gas analyzers (i.e., monitox) and real-time aerosol monitors (i.e., RAM and miniram).

C Total Hydrocarbon Analyzers

Total hydrocarbon analyzers used to detect a variety of volatile organic compounds (VOCs) at hazardous waste sites principally employ either a photoionization detector (PID) or a flame ionization detector (FID). Compounds are ionized by a flame or an ultraviolet lamp. PIDs depend on the ionization potential of the compounds. PIDs are sensitive to aromatic and olefinic (unsaturated) compounds such as benzene, toluene, styrene, xylenes, and acetylene. Greater selectivity is possible by using low-voltage lamps. The ionization potential of individual compounds can be found in the NIOSH Pocket Guide to Chemical Hazards. These instruments are not compound-specific and are typically used as screening instruments. FIDs are sensitive to volatile organic vapor compounds such as methane, propanol, benzene and toluene. They respond poorly to organic compounds lacking hydrocarbon characteristics.

C Oxygen and Combustible Gas Indicators

Combustible Gas Indicators (CGIs) provide efficient and reliable methods to test for potentially explosive atmospheres. CGI meters measure the concentration of a flammable vapor or gas in air and present these measurements as a percentage of the lower explosive limit (LEL).

The measurements are temperature-dependent. The property of the calibration gas determines sensitivity. LELs for individual compounds can be found in the NIOSH Pocket Guide to Chemical Hazards. If readings approach or exceed 10% of the LEL, extreme caution should be exercised in continuing the investigation. If readings approach or exceed 25% LEL, personnel should be withdrawn immediately.

CGIs typically house an electrochemical sensor to determine the oxygen concentration in ambient air. Normally, air contains approximately 20.9% oxygen by volume. Oxygen measurements are of particular importance for work in enclosed spaces, low-lying areas, or in the vicinity of accidents that have produced heavier-than-air vapors which could displace ambient air. The meters are calibrated for sea level and may indicate a false negative (i.e, O_2 content) at higher altitudes. Since the air has been displaced by other substances, these oxygen-deficient areas are also prime locations for taking additional organic vapor and combustible gas measurements. Oxygen-enriched atmospheres increase the potential for fires by their ability to contribute to combustion or to chemically react with flammable compounds and promote auto-ignition.

C Toxic Atmosphere Analyzers

The toxic atmosphere analyzer is a compound-specific instrument designed and calibrated to identify and quantify a specific compound or class of compounds in either gaseous or vapor form. Cross-sensitivity to air pollutants not of interest may be lead to erroneous results.

U.S. EPA/ERT has the following toxic atmosphere analyzers: carbon monoxide, phosgene, nitrous oxide, hydrogen cyanide, sulfur dioxide, hydrogen sulfide, and chlorine gas.

C Aerosol/Particulate Monitors

A Real-Time Aerosol/Particulate Monitor (RAM) displays readings for total particulates. The instrument employs a pulse light emitting diode which generates a narrow band emission in conjunction with a photovoltaic cell to detect light scattered from particulates.

The U.S. EPA/ERT uses the RAM when the contaminant of concern is associated with particulates, and when responding to fires involving hazardous materials, to identify plume levels. The instrument is very useful in determining the presence of a plume when it is not visible. The U.S. EPA/ERT typically uses RAMs on tripods to obtain particulate concentrations at the breathing zone level. Personal dataloggers are used with the RAMs to document minimum, average and maximum concentrations. This provides real-time data without requiring those in personal protective equipment to be constantly present in the plume.

C Chemical Detector Tubes (Colorimetric Tubes)

A chemical detector tube is a hollow, tube-shaped, glass body containing one or more layers of chemically impregnated inert material. To use, the fused ends are broken off and a manufacturer-specified volume of air is drawn through the tube with a pump to achieve a given detection limit. The chemicals contained within the packing material undergo a chemical reaction with the airborne pollutant present, producing a color change during the intake of each pump stroke. The concentration of a pollutant is indicated by the length of discoloration on a calibrated scale printed on the detector tube.

C Radiation Meters

Radiation meters determine the presence and level of radiation. The meters use a gas or solid ion detection media which becomes ionized when radiation is present. The meters are normally calibrated to one probe. Meters that detect alpha, beta, and gamma radiation are available.

C Gold Film (Hydrogen Sulfide and Mercury Vapor) Monitors

Hydrogen sulfide (H_2S) and Mercury (Hg) monitors operate on the principle that electric resistivity increases across a gold film as a function of H_2S and Hg concentration. The monitors provide rapid and relatively low detection limits for H_2S and Hg in air. After extensive sampling periods or high concentrations of H_2S and Hg, the gold film must be heated to remove contamination and return the monitor to its original sensitivity.

C Infrared Detectors

Infrared detectors such as the Miniature Infrared Analyzer (MIRAN) use infrared (IR) absorption as a function of specific compounds. MIRAN instruments apply to situations where the contaminants are identified but concentrations are not. MIRAN instruments generally require AC power.

SPECIALIZED ANALYTICAL INSTRUMENTS

The continuous monitors described above provide qualitative measurement of air contaminants. Quantitative measurements in the field can be obtained using more sophisticated instruments, such as portable Gas Chromatographs, to analyze grab samples.

C Direct Air Sampling Portable Gas Chromatographs (GCs)

Portable GCs use gas chromatography to identify and quantify compounds. The time it takes for a compound to move through a chromatographic column is a function of that specific compound or group of compounds. A trained technician with knowledge of the range of expected concentrations of compounds can utilize a portable GC in the field to analyze grab samples. GCs generally require AC power and shelter to operate. This method is limited by its reliance on a short-term grab sample to be representative of the air quality at a site.

- Remote Optical Sensing

  This technique, also referred to as long-path or open-path monitoring, involves transmitting either an infrared or ultraviolet light beam across a long open path and measuring the absorbance at specific wavelengths. The technique is capable of analyzing any preselected organic or inorganic volatile compound that can be resolved from compounds naturally occurring in ambient air. Current projected removal applications include perimeter monitoring during site cleanups and measurement of emission source strengths during site assessments.

- TAGA Direct Air Sampling Mass Spectrometer/Mass Spectrometer

  The Trace Atmospheric Gas Analyzer (TAGA), which is operated by the U.S. EPA/ERT, is capable of real-time detection of preselected organic compounds at low parts-per-billion concentrations. The instrument has been successfully used by the U.S. EPA/ERT for isolating individual emission plumes and tracking those plumes back to their sources.

APPENDIX B

Air Sampling Equipment and Media/Devices

AIR SAMPLING EQUIPMENT

C High-Volume. Total Suspended Particulate (TSP) Samplers

High-volume TSP samplers collect all suspended particles by drawing air across an 8- by 10-inch glass-quartz filter. The sample rate is adjusted to 40 cubic feet per minute (CFM), or 1134 liters per minute (L/min), and it is held constant by a flow controller over the sample period. The mass of TSPs can be determined by weighing the filter before and after sampling. The composition of the filter varies according to the analytical method and the detection limit required.

C PM-10 Samplers

PM-10 samplers collect particulates with a diameter of 10 microns or less from ambient air. Particulates of this size represent the respirable fraction, and thus are of special significance. PM-10 samplers can be high-volume or low-volume. The high-volume sampler operates in the same manner as the TSP sampler at a constant flow rate of 40 CFM; it draws the sample through a special impactor head which collects particulates of 10 microns or less. The particulate is collected on an 8- by 10-inch filter. The low-volume sampler operates at a rate of approximately 17 L/min. The flow must remain constant through the impactor head to maintain the 10-micron cut-off point. The low-volume PM-10 collects the sample on 37-mm Teflon filters.

C High-Volume PS-1 Samplers

High-volume PS-1 samplers draw a sample through polyurethane foam (PUF) or a combination foam and XAD-2 resin plug, and a glass quartz filter at a rate of 5-10 CFM (144 to 282 L/min). This system is excellent for measuring low concentrations of semivolatiles, PCBs, pesticides, or chlorinated dioxins in ambient air.

C Area Sampling Pumps

These pumps provide flow-rate ranges of 2-20 L/min and have a telescopic sampling mast with the sampling train. Because of the higher volume, this pump is suitable for sampling low concentrations of airborne contaminants (i.e., asbestos sampling). These pumps are also used for metals, pesticides and PAH sampling which require large sample volumes.

C Personal Sampling Pumps

Personal sampling pumps are reliable portable sampling devices that draw air samples through a number of sampling media including resin tubes, impingers, and filters. Flow rates are usually adjustable from 0.1 to 4 L/min (or 0.01 to .75 L/min with a restrictive orifice) and can remain constant for up to 8 hours on one battery charge or continuously with an AC charger/converter.

C Canister Samplers

Evacuated canister sampling systems use the pressure differential between the evacuated canister and ambient pressure to bleed air into the canister. The sample is bled into the canister at a constant rate over the sampling period using a critical orifice, a mechanically compensated regulator, or a mass flow control
device until the canister is near atmospheric pressure.

Pressure canister sampling systems use a pump to push air into the canister. To maintain a higher, more controlled flow, the pump typically controls the pressure differential across a critical orifice at the inlet of the canister, resulting in a pressurized canister at the completion of sampling.

AIR SAMPLING MEDIA/DEVICES

If possible, before employing a specific sampling method, consult the laboratory that will conduct the analyses. Many of the methods can be modified to provide better results or a wider range of results.

C Summa^{R} Canisters

Summa canisters are highly polished passivated stainless steel cylinders. The Summa polishing process brings chrome and nickel to the surface of the canisters, which results in an inert surface. This surface restricts adsorption or reactions that occur on the canister's inner surface after collection. At the site, the canister is either placed in a sampler to control sample collection rate, or opened to collect a grab sample. Samples can be collected by allowing air to bleed into or be pumped into the canister. U.S. EPA/ERT uses 6-liter Summa canisters for VOC and permanent gas analysis.

C Passive Dosimeters

Passive dosimeters are clip-on vapor monitors (samplers) in which the diffused contaminants are absorbed on specially prepared active surfaces. Industrial hygienists commonly use dosimeters to obtain time-weighted averages or concentrations of chemical vapors, as they can trap over 130 organic compounds. Selective dosimeters have also been developed for a number of chemicals including formaldehyde, ethylene oxide, hydrogen sulfide, mercury vapor, nitrogen dioxide, sulfur dioxide, and ozone. Dosimeters must be sent to a laboratory for analysis.

C Polyurethane Foam (PUF)

PUF is a sorbent used with a glass filter for the collection of semivolatile organic compounds such as pesticides, PCBs, chlorinated dioxins and furans, and PAHs. Fewer artifacts (chemical changes that occur to collected compounds) are produced than with some other solid sorbents. PUF is used with the PS-1 sampler and U.S. EPA Method TO13. PUF can also be used with personal sampling pumps when sampling for PAHs using the Lewis McCloud method. Breakthrough of the more volatile PCBs and PAHs may occur when using PUF.

C Sampling Bags (Tedlar^{R})

Sampling bags, like canisters, transport air samples to the laboratory for analysis. Samples are generally pumped into the bags, but sometimes a lung system is used, in which a pump creates a vacuum around the bag in a vacuum box. Then the sample flows from a source into the bag. This method is used for VOCs, fixed gases (CO_2, O_2, and N_2) and methane.

C Impingers

An impinger allows an air sample to be bubbled through a solution, which collects a specific contaminant by either chemical reaction or absorption. For long sampling periods, the impinger may need to be kept in an ice bath to prevent the solution from evaporating during sampling. The sample is drawn through the impinger by using a sampling pump or more elaborate sampling trains with multiple impingers.

C Sorbent Tubes/Cartridges

A variety of sampling media are available in sorbent tubes, which are used primarily for industrial hygiene. A few examples are carbon cartridges, carbon molecular sieves, Tenax tubes and tube containing the XAD-2 polymer. Depending upon the sorbent material, tubes can be analyzed using either a solvent extraction or thermal desorption. The former technique uses standard laboratory equipment and allows for multiple analyses of the same sample. The latter technique requires special, but readily available, laboratory equipment and allows only one analysis per sample. In addition, thermal desorption typically allows for lower detection limits by two or more orders of magnitude. Whenever sorbent tubes are being used for thermal desorption, they should be certified as "clean" by the laboratory doing the analysis.

Thermally Desorbed Media

During thermal desorption, high-temperature gas streams are used to remove the compounds collected on a sorbent medium. The gas stream is injected and often cryofocused into an analytical instrument, such as a GC, for compound analysis:

C Tenax Tubes

Tenax tubes are made from commercially available polymer (p-phenylene oxide) packed in glass or stainless steel tubes through which air samples are drawn or sometimes pumped. These tubes are used in U.S. EPA Method TO1 and VOST for volatile nonpolar organic, some polar organic, and some of the more volatile semivolatile organics. Tenax is not appropriate for many of the highly volatile organics (with vapor pressure greater than approximately 200 mm Hg).

C Carbonized Polymers

The carbonized molecular sieve (CMS), a carbonized polymer, is a commercially available, carbon sorbent packed in stainless-steel sampling tubes through which air samples are drawn or sometimes pumped. These are used in U.S. EPA Method TO2 for highly volatile nonpolar compounds which have low-breakthrough volumes on other sorbents. When high-thermal desorption temperatures are used with CMS, more variability in analysis may occur than with other sorbents.

C Mixed Sorbent Tubes

Sorbent tubes can contain two type of sorbents. Combining the advantages of each sorbent into one tube increases the possible types of compounds to be sampled. The combination of two sorbents can also reduce the chance that highly volatile compounds will break through the sorbent media. An example of a mixed-sorbent tube is the combination of Tenax and charcoal with a carbonized molecular sieve. A potential problem with mixed sorbent tubes is the breakthrough of a compound from an earlier sorbent to a later sorbent from which it cannot be desorbed.

Solvent-Extracted Media

Solvent-extracted media use the principle of chemical extraction to remove compounds collected on a sorbent media. The chemical solvent is injected into an instrument, such as a GC, for analysis of compounds. Examples of solvent-extracted media follow:

C Chemically Treated Silica Gel

Silica gel is a sorbent which can be treated with various chemicals. The chemically treated silica gel can then be used to sample for specific compounds in air. Examples include the DNPH-coated silica gel cartridge used with U.S. EPA Method TO11.

C XAD-2 Polymers

XAD-2 polymers usually are placed in tubes, custom-packed sandwich-style with polyurethane foam, and prepared for use with U.S. EPA Method TO13 or the semi-VOST method. The polymers are used for the collection of semivolatile polar and nonpolar organic compounds. The compounds collected on the XAD-2 polymer are chemically extracted for analysis.

C Charcoal Cartridges

Charcoal cartridges, consisting of primary and backup sections, trap compounds by adsorption. Ambient air is drawn through them so that the backup section verifies that breakthrough of the analytes on the first section did not occur, and the sample collection was therefore quantitative. Quantitative sample collection is evident by the presence of target chemicals on the first charcoal section and the absence on the second section. Next, the adsorbed compounds must be eluted, usually with a solvent extraction, and analyzed by GC with a detector, such as a Mass Spectrometer (MS).

C Tenax Tubes

Cartridges are used in OSHA and NIOSH methods in a manner similar to charcoal cartridges, but typically for less volatile compounds.

Particulate Filters

Particulate filters are used by having a sampling pump pass air through them. The filter collects the particulates present in the air and is then analyzed for particulate mass or chemical or radiological composition. Particulate filters are made from different materials which are described below.

C Mixed Cellulose Ester (MCE)

MCE is manufactured from mixed esters of cellulose which are a blend of nitro-cellulose and cellulose acetate. MCE filters are used often for particulate sampling.

C Glass Fiber

Glass fiber is manufactured from glass fibers without a binder. Particulate filters with glass fiber provide high flow rates, wet strength, and high, solid holding capacity. Generally, the filters are used for gravimetric analysis of particulates.

C Polyvinyl Chloride

Particulate filters with polyvinyl chloride are resistant to concentrated acids and alkalis. Their low moisture pickup and light tare weight make them ideal for gravimetric analysis.

C Teflon

Teflon is manufactured from polytetrafluorethylene (PTFE). Particulate filters with Teflon are easy to handle and exceptionally durable. Teflon filters are used for metal collection.

C Silver

Particulate filters manufactured from pure silver have high collection efficiency and uniform pore size. These filters are used for mercury collection and analysis.

C Cellulose

Particulate filters with cellulose contain less than 0.01% ash. These filters are used to collect particulates.

AIR SAMPLING FOR METALS [NIOSH Method 7300, Elements]

SOP#: 2119
DATE: 10/07/94
REV. #: 0.0

1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to define the proper sample collection technique for air sampling for elements (metals), as well as delineate the typical working range of the method and indicate potential interferences. Elements covered by this method include the metals listed in Table 1 (Appendix A).

These are standard (i.e., typically applicable) operating procedures which may be varied or changed as required, dependent upon site conditions, equipment limitations or limitations imposed by the procedure. In all instances, the ultimate procedures employed should be documented and associated with the final report.

Mention of trade names or commercial products does not constitute U.S. Environmental Protection Agency (U.S. EPA) endorsement or recommendation for use.

2.0 METHOD SUMMARY

Air sampling for elements (metals) involves passing a known quantity of air across a mixed cellulose ester (MCE) filter. The particulate phase of the air, with a nominal size of greater than or equal to 0.8 microns (µm), is trapped in the filter.

This method requires air sampling utilizing 37 millimeter (mm), 3-stage cassettes loaded with 0.8 um MCE filters and support pads. The approximate minimum and maximum sample volumes required for detection of the metals of interest are listed in Table 1 (Appendix A).

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

No preservatives or special storage conditions are required. However, the samples should be stored with the filter upright and transported at or near ambient conditions to prevent significant deterioration of the samples. When transporting and handling the samples, prevent impact and vibrations which would dislodge particulates from the filters.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

A potential problem with the sampling method is over-loading of the filter. This can disrupt flow, consequently producing falsely low analytical results. Periodic checking of the filter and pump can predict this condition and sample cassettes can be changed during the sampling period. The multiple filters would be analyzed as one sample with the total volume indicated on the Chain of Custody record.

5.0 EQUIPMENT/APPARATUS

The following equipment is required for air sampling for elements:

- C Low or medium volume air pumps
- C Tygon tubing
- C 0.8 µm MCE filters with support pads
- C 37 mm 3-stage cassettes
- C Hose-barb filter adapters
- C Air flow calibration standard (calibrated rotameter or bubble meter)
- C Screw driver set
- C Air Sampling Worksheets and sample labels
- C Chain of Custody records
- C Particulate monitoring equipment (RAM)
- C Protective clothing
- C Whirl bags

6.0 REAGENTS

This section is not applicable to this SOP.

7.0 PROCEDURE

7.1 Preparation

1. Determine the extent of the sampling effort, the sampling methods to be employed, and the types and amounts of equipment and supplies needed.

2. Obtain and organize the necessary sampling and monitoring equipment.

3. Decontaminate or pre-clean equipment, and ensure that it is in working order. Precalibrate sampling equipment, if possible.

4. Prepare scheduling and coordinate with staff, client, and regulatory agency, if appropriate.

5. Perform a general site survey prior to site entry in accordance with the site-specific Health and Safety Plan.

6. Use stakes, flagging tape, or other appropriate means to mark all sampling locations. If necessary, the proposed locations may be adjusted based on site access, property boundaries, and surface obstructions.

7. Make an estimate of the airborne concentrations of the elements of concern. It may be possible to extrapolate the concentration of particulates by assuming similar percentages of metals are present in the airborne particulates as in the soils. However, it should be noted that this is only a rough estimate. If estimation of the airborne concentration of metals is not possible, then sample volumes should remain within the limits recommended in Table 1 (Appendix A).

8. Arrange for sample analysis by an appropriately certified laboratory and check with the laboratory for any special requirements (e.g., additional lot blanks).

7.2 Calibration

Calibrate the required number of sampling pumps in the following manner:

1. Assemble the calibration train as shown in Figure 1 (Appendix A) using a representative 37 mm, 3-stage filter cassette loaded with a 0.8 µm MCE filter and support pad (outlet plug removed), tygon tubing, a hose-barb filter adapter, a rotameter, and an air sampling pump. Depending on the required flow rate, a low volume or a medium volume sampling pump may be required. Refer to Figure 2 (Appendix A) for an illustration of the components of the filter cassette.

2. Turn on the pump and adjust the flow using the flow adjust mechanism until the float ball on the rotameter is aligned with the rotameter's precalibrated flow rate value. A sticker on the rotameter should indicate this value.

3. Affix a sticker to the pump indicating flow rate and media.

7.3 Sampling

1. Assemble the sampling trains with clean filter cassettes (Figures 3 and 4, Appendix A).

2. Verify the pump calibration by removing the inlet plug from the cassette, attaching a rotameter with Tygon tubing and turning on the sampling pump. Ensure that all connections are tight. Record the actual flow rate on the Air Sampling Worksheet. Replace the inlet plug until ready to sample.

3. Set the sampling pump timer (low volume pumps) for the appropriate sampling time as determined by the Work Assignment Manager, or record the elapsed timer readings (medium volume pumps) on the Air Sampling Worksheet. This will be dictated by the type of sampling pump being utilized.

4. Deploy the sampling pumps as indicated in the sampling plan, following site health and safety procedures.

5. Remove the cassette cap or inlet plug from the cassette. Sampling for elements can be conducted with the cassettes open-faced (cassette cap removed) or closed-faced (only inlet port plug removed). Open-faced is preferred because it permits an even loading of the filter cassette and should be used

whenever high particulate concentrations are expected. This allows greater particulate loading of the filter. However, either method is acceptable since the entire filter is used during sample analysis. Closed-faced sampling is typically performed when there is a possibility that the sample may be shaken and particulates may be lost.

6. Turn on the sampling pump and allow it to run for the sampling period determined by the Work Assignment Manager.

7.4 Post Sampling

1. Verify the sampling period by reading the sample run time (low volume pumps) or by checking the elapsed time on the counter (medium volume pumps). Record the sampling time on the Air Sampling Worksheet and turn off the pump.

2. Verify the pump calibration by attaching a rotameter with Tygon tubing and turning on the sampling pump. Record the actual flow rate on the Air Sampling Worksheet. Insert the inlet plug.

3. Remove the sampling cassette from the sampling train and insert the outlet plug.

4. Complete the Air Sampling Worksheet and calculate the sample volume.

5. Label the sample and place it in a whirl bag for transport to the laboratory for analysis.

6. Prepare the samples (including QC samples) for transport by packing them in a shipping container with bubble wrap or styrofoam pieces. Complete a Chain of Custody record in accordance with applicable Chain of Custody Procedures.

8.0 CALCULATIONS

The total volume of a sample is calculated by multiplying the total sample time by the flow rate. The total volume for each sample must be indicated on the Chain of Custody Record.

9.0 QUALITY ASSURANCE/ QUALITY CONTROL

The following general QA procedures apply:

1. All data must be documented on Air Sampling Worksheets or within site logbooks.

2. All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior to sampling/operation and they must be documented.

The following specific QC activities apply:

1. Provide one field blank per sampling event or per 20 samples, whichever is greater. The field blank should be handled in the same manner as the sampling cassette (remove/replace cap and plug, and transport) except that no air is drawn through it.

2. Collect one collocated sample per sampling event or per 10 samples, whichever is greater. Collocated samples are two samples collected adjacent to each other during the same time period at the same flow rates.

3. Include a minimum of two lot blanks per manufacturer's lot of sampling cassettes utilized per sampling event. Consult with the analytical laboratory to determine if additional lot blanks are required.

10.0 DATA VALIDATION

Results of the QA/QC samples will be evaluated for contamination. This information will be utilized to qualify the environmental sample results accordingly with the project's data quality objectives.

11.0 HEALTH AND SAFETY

When working with potentially hazardous materials, follow U.S. EPA, OSHA, or corporate health and safety procedures.

12.0 REFERENCES

[1]NIOSH Manual of Analytical Methods, NIOSH Method 7300, Elements (ICP) (Issued 02/15/84).

APPENDIX A

Table

TABLE 1. Metal Concentrations are Anticipated to be at or Near the Threshold Limit Value (TLV)

Element (Symbol)	Minimum Air Volume to be collected - Liters	Maximum Air Volume to be collected - Liters
Silver (Ag)	250	2000
Aluminum (Al)	5[1]	100[1]
Arsenic (As)	5	2000
Beryllium (Be)	1250	2000
Calcium (Ca)	5	200
Cadmium (Cd)	13	2000
Cobalt (Co)	25	2000
Chromium (Cr)	5	1000
Copper (Cu)	5	1000
Iron (Fe)	5	100
Lithium (Li)	100	2000
Magnesium (Mg)	5	67
Manganese (Mn)	5	200
Molybdenum (Mo)	5	67
Sodium (Na)	13	2000
Nickel (Ni)	5	1000
Phosphorus (P)	25[1]	2000[1]
Lead (Pb)	50	2000
Platinum (Pt)	1250	2000
Selenium (Se)	13	2000
Tin (Sn)	5	500
Tellurium (Te)	25	2000
Titanium (Ti)	5	100
Thallium (Tl)	25	2000
Vanadium (V)	5	2000
Tungsten (W)	5[1]	200[1]
Yttrium (Y)	5	1000
Zinc (Zn)	5	200
Zirconium (Zr)	5	200

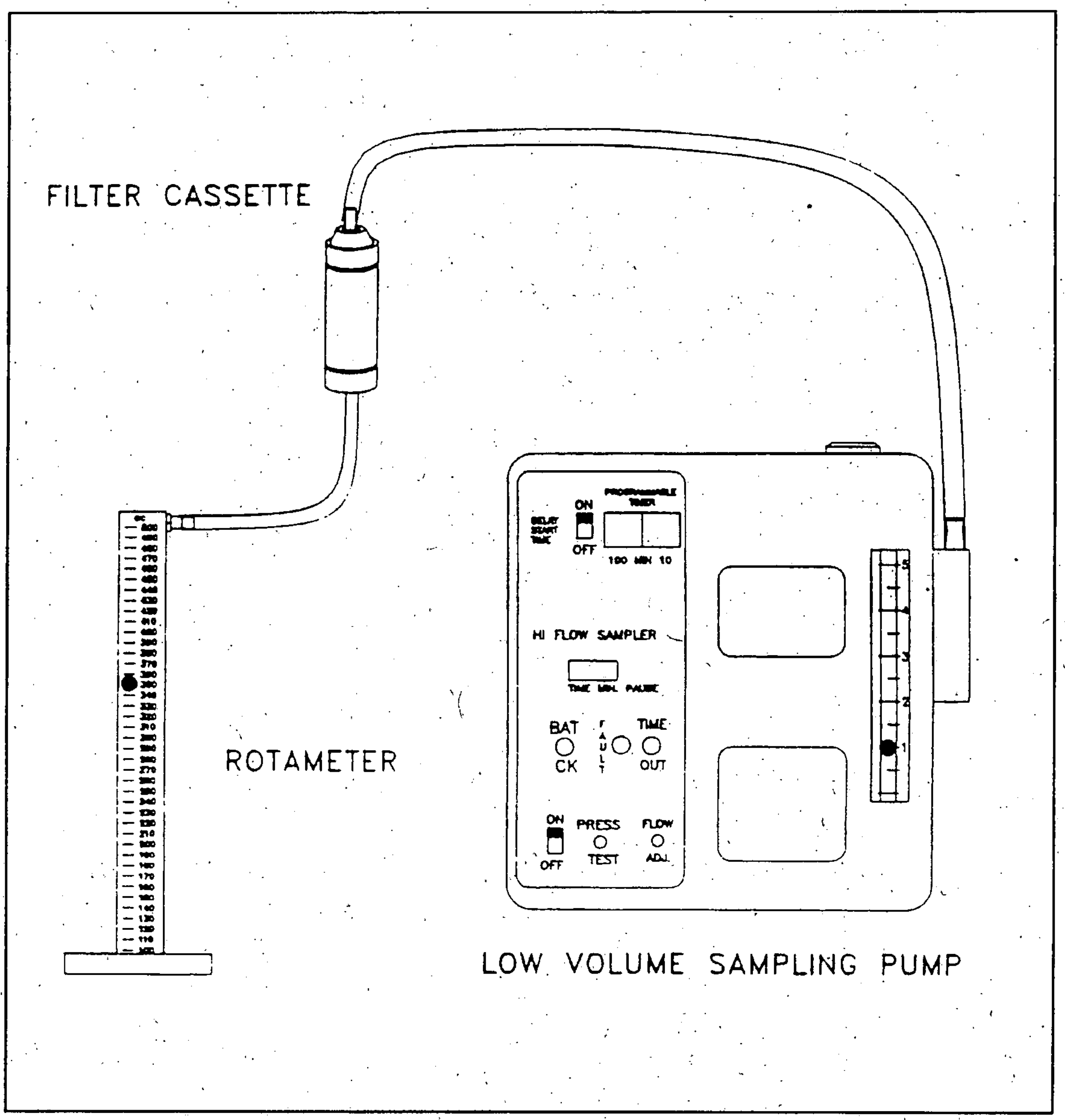
NOTE: Do not exceed a filter loading of approximately 2mg total dust.

[1] Greater volumes may be required if the anticipated concentration is less than the ACGIH TLV.

APPENDIX B

Figures

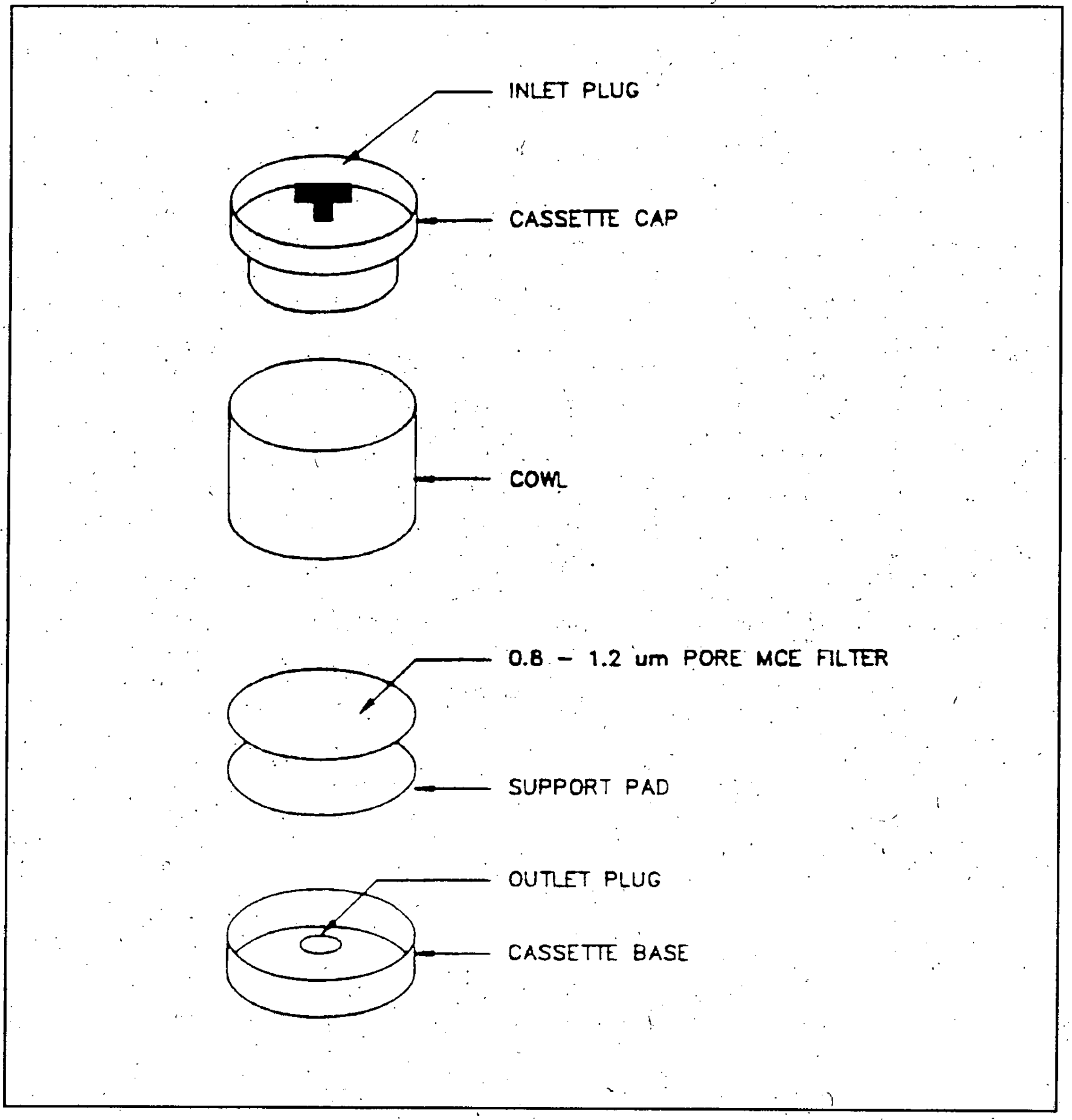
FIGURE 1. Calibration Train with Low Volume Sampling Pump



APPENDIX B (Cont'd)

Figures

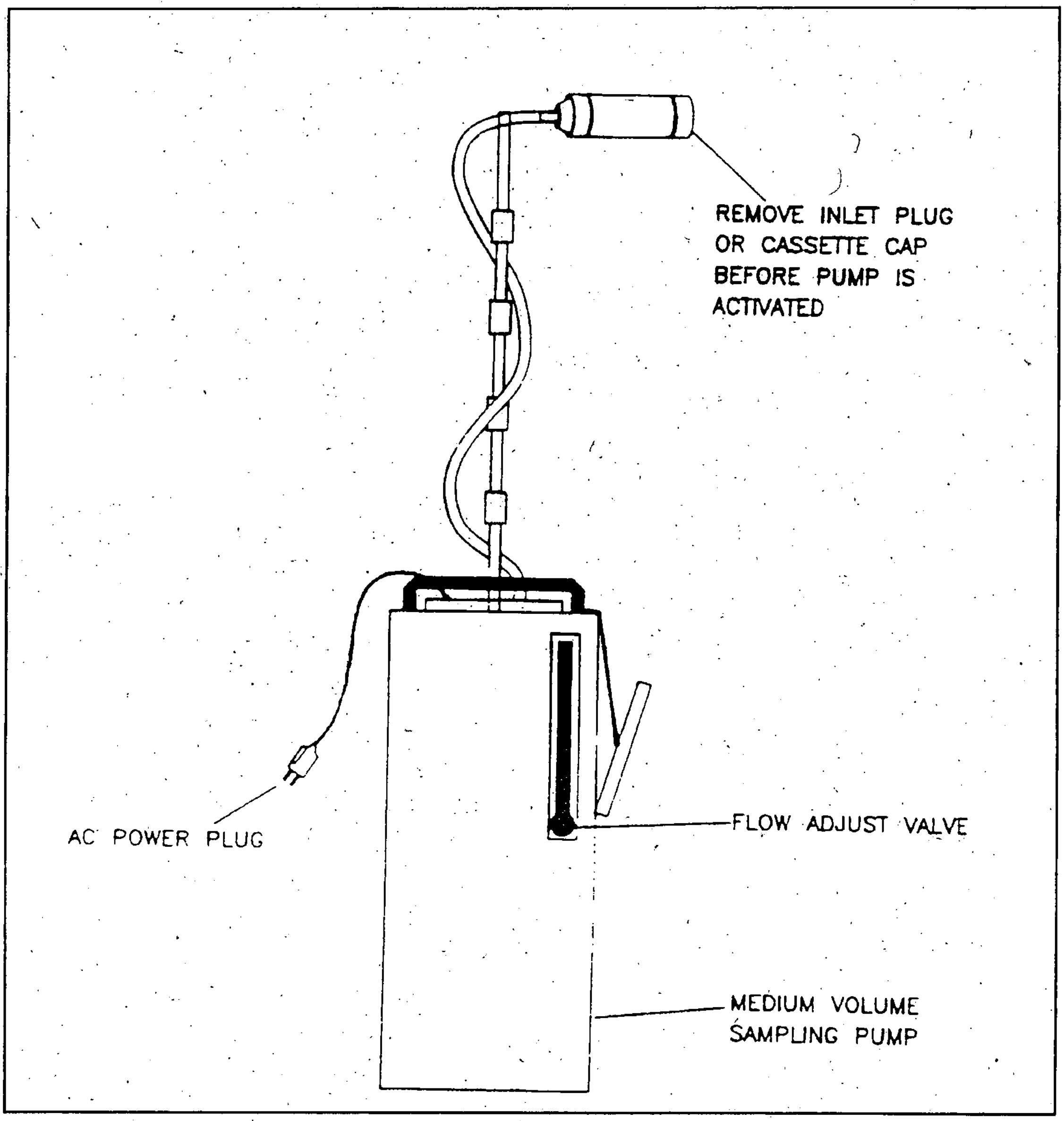
FIGURE 2. Filter Cassette Assembly



APPENDIX B (Cont'd)

Figures

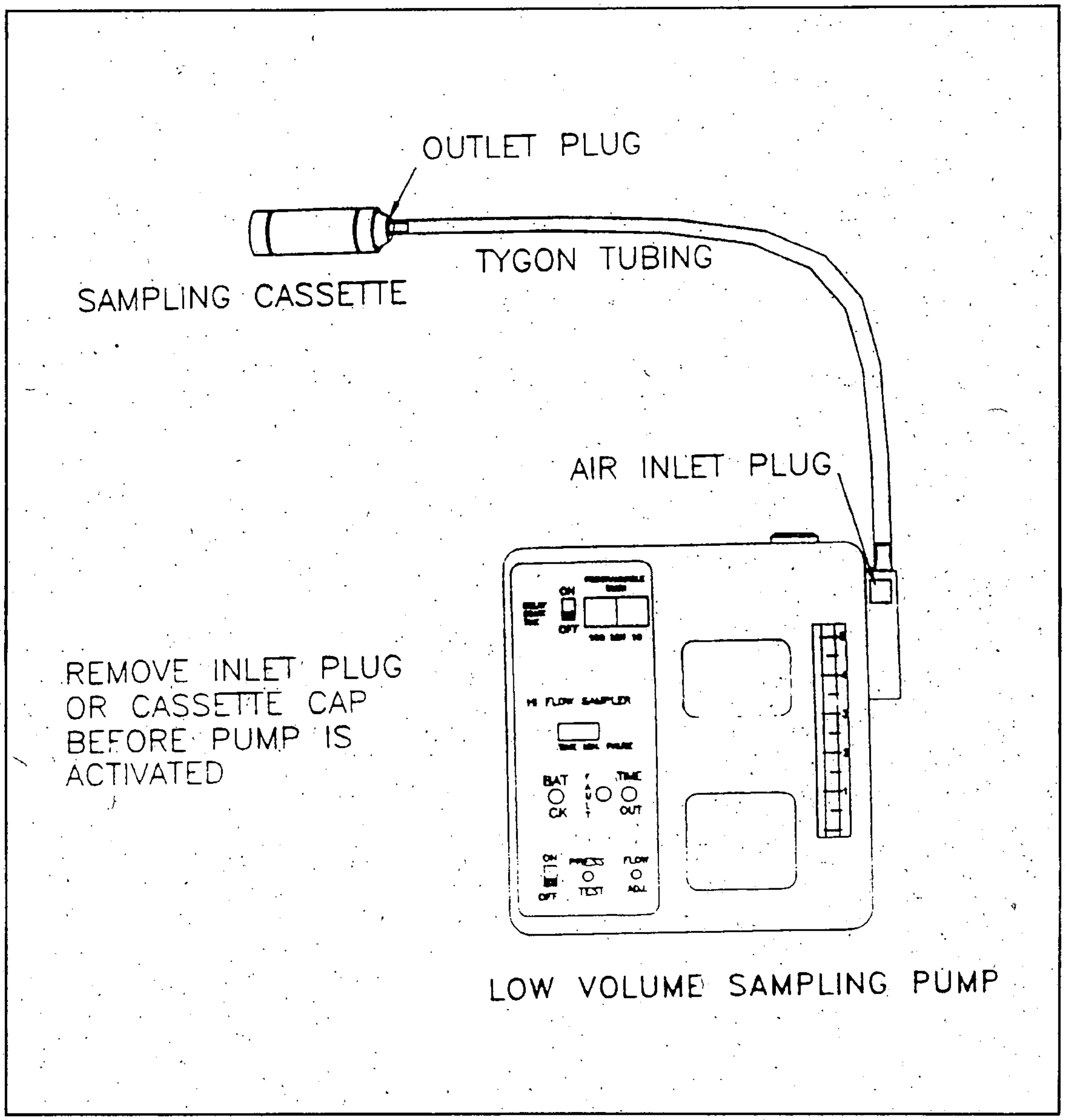
FIGURE 3. Medium Volume Sampling Train



APPENDIX B (Cont'd)

Figures

FIGURE 4. Sampling Train with Low Volume Sampling Pump



ATTACHMENT C

AIR SAMPLING WORK SHEET

United States Environmental Protection Agency
Removal Support Team
Air Sampling Work Sheet

Weston Solutions, Inc.
EPA Contract No. 68-W-00-113

Site: Jewett White Lead Company

Sampler: ______________________ U.S. EPA: Nick Magriples

Date: ______________________ RST Site Project Manager G. Boyer

Sample #						
Location						
Pump #						
Media	0.8 um MCEF, 37mm	0.8 um MCEF, 37mm	0.8 um MCEF, 37mm	0.8 um MCEF, 37mm	0.8 um MCEF, 37mm	0.8 um MCEF, 37mm
Analysis/Method	Lead / NIOSH 7300	Lead / NIOSH 7300	Lead / NIOSH 7300	Lead / NIOSH 7300	Lead / NIOSH 7300	Lead / NIOSH 7300
Time (Start)						
Time (Stop)						
Total Time						
Pump Fault	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N
Flow Rate (Start)	L/min	L/min	L/min	L/min	L/min	L/min
Flow Rate (End)	L/min	L/min	L/min	L/min	L/min	L/min
Flow Rate (Average)	L/min	L/min	L/min	L/min	L/min	L/min
Sampling Volume	Liters	Liters	Liters	Liters	Liters	Liters

NOTES